Cinema Handbook

A. C. Lescarboura

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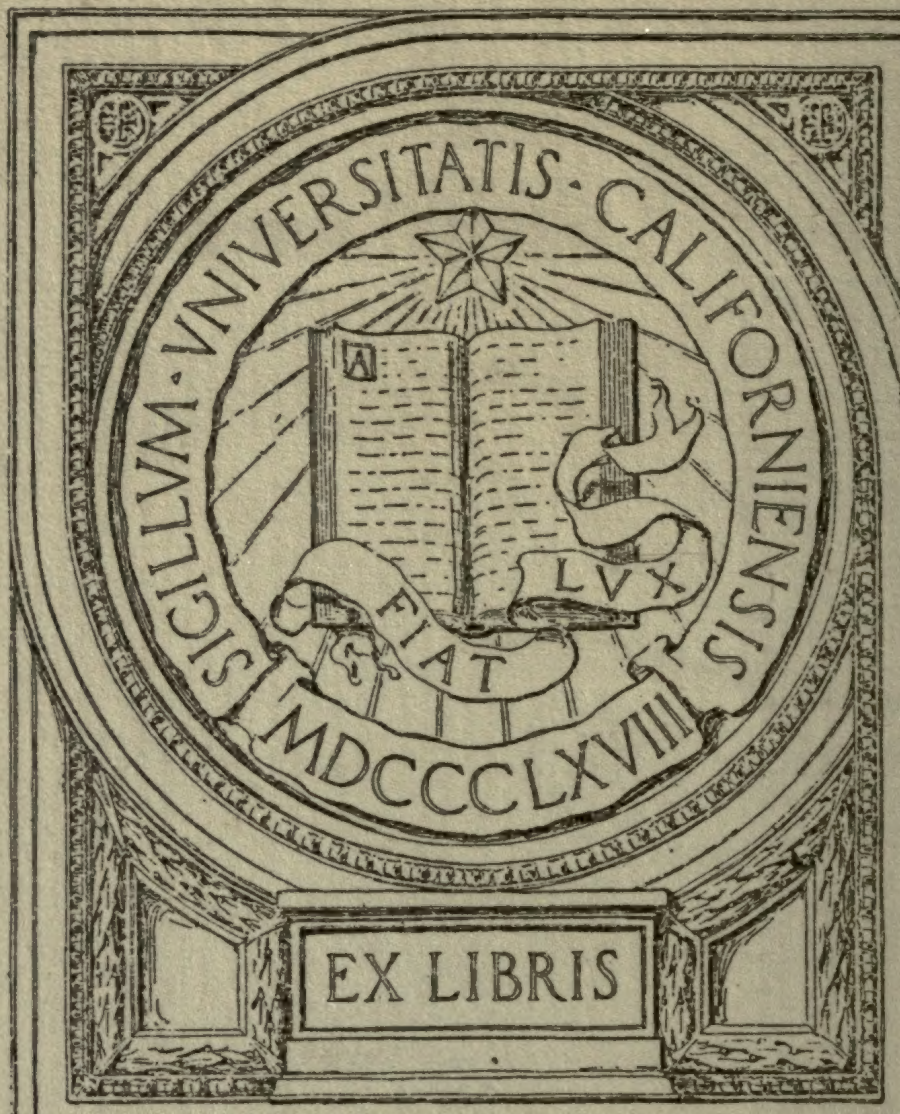

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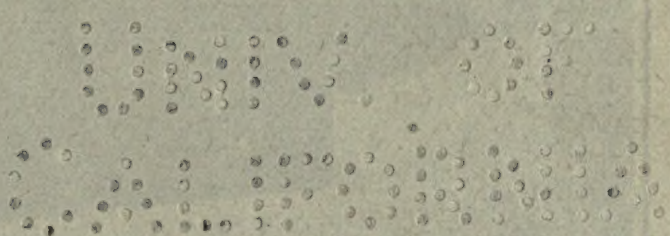

THE MOTION PICTURE CAMERAMAN AND HIS OUTFIT AND LUGGAGE, READY FOR A LONG JOURNEY

THE CINEMA HANDBOOK

A GUIDE to practical motion picture work of the non-theatrical order, particularly as applied to the reporting of news, to industrial and educational purposes, to advertising, selling and general publicity, to the production of amateur photoplays, and to entertainment in the school, church, club, community center and home.

BY

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Author of "Behind the Motion Picture Screen," etc.

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PREFACE

THE possibilities of the motion picture screen are almost without limit. Year after year the screen is put to still greater use in the divers fields of entertainment, publicity, education, research, propaganda of all kinds, and so on. Indeed, it seems but a matter of time when the theatrical phase of the motion picture industry will be a minor one, because of the wide application of cinematography in business, college, school, church, club, and home.

With a growing appreciation of the importance of non-theatrical cinematog-

raphy, I turned to motion pictures as a hobby some five years ago. Beginning with an inexpensive camera which, by the mere addition of an incandescent lamp, could be converted into a projector, I undertook the filming of educational and news subjects for the news and magazine reels. From that first and simple outfit, I went to better equipment and by a process of evolution I finally came to professional cameras and projectors.

Some two years ago I wrote the work entitled "Behind the Motion Picture Screen," which was intended as a book of general information on the broad subject of motion pictures. No sooner did the book gain a fair degree of circulation than I was veritably flooded with inquiries from even the farthermost corners of the world, asking for more definite information on the selection, operation and

application of motion picture equipment. It was in order to answer these inquiries and many potential inquiries that I set to work putting my experiences and collated data down on paper. And here is the result.

Please do not misunderstand this work. It is not intended for the professional motion picture man, for it must needs be too elementary for him. But it is intended for the non-theatrical worker who wishes to make use of motion pictures for pleasure or for profit. It is intended for the industrialist who wants to know the possibilities of the screen in his activities, and how to realize them. It is intended for the naturalist, traveler, explorer, microscopic worker, teacher, engineer, and others who would aspire to seeing their work on the screen. It is intended for those who seek the highest form of

entertainment for the club, church, school, community gathering or the home.

If this work should help others to secure the enjoyment, profit, and broadened knowledge which I have received in its preparation, I shall feel more than amply remunerated for the effort.

A. C. L.

New York, N. Y.
September 5th, 1921.

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Chapter I.

PRINCIPLES OF MOTION PICTURE APPARATUS

PHOTOGRAPHY is nothing more than the gathering of the reflected or direct rays from any object or group of objects, and bringing them to a surface that is sensitized to light in such a manner that it undergoes certain chemical changes. These changes only become evident when the sensitized surface is treated with certain chemicals, and since the original sensitized surface employed in the camera usually gives the reproduction of the object or group of objects photographed in negative terms—with the whites showing in black, and the blacks showing in white, it is necessary to transfer the negative image on to another sensitized surface by passing light through it. This is known as the printing process. Where the negative is most transparent, the most light will pass through and make the second sensitized surface, known as the positive, the darkest, and vice versa. So the blacks and whites and half-tones of the original subject are rendered more or less faithfully in the positive reproduction.

So it is evident that the starting point in all pho-

tography is a means of gathering light. While it is true that photographs can be made by means of pin-holes, it is just as true that such photographs require an exposure of many minutes; hence schemes of this kind are not practical for the usual run of work. Furthermore, the pin-hole camera does not render the crisp definition that is obtained with a lens. Therefore, all cameras for practical purposes must use a lens of some kind or other for gathering the rays coming directly or being reflected from the object to be photographed, and concentrating them on to the negative.

Lenses play such an important part in all forms of photography that it is perhaps well to give a brief treatise on photographic optics at this point, compiled from information supplied in largest measure by the Bausch & Lomb Optical Company of Rochester, N. Y.

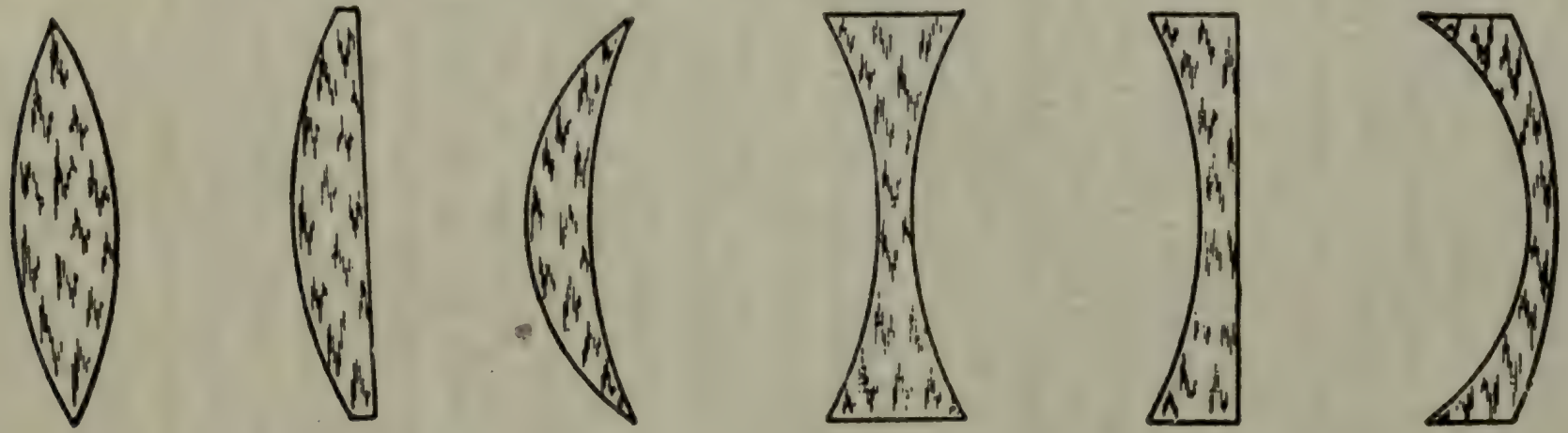
The A B C of Lenses

Technical terms used in photography are often puzzling to the amateur, particularly, perhaps, those terms which relate to the science of optics. The following glossary of optical terms has been prepared with a view to giving general information as to the descriptive words and phrases in ordinary use.

Equivalent Focal Length: Focal plane is the plane in which a far distant object is imaged by the lens. The line drawn perpendicularly through the center of the lens is its optical axis; the point at which the focal plane intersects the optical axis, the focal point of the lens.

Converging Lenses

Diverging Lenses



Double Convex

Plano Convex

Periscopic Convex (Positive Meniscus)

Double Concave

Plano Concave

Periscopic Concave (Negative Meniscus)

Thicker in the middle than at the edge

Thinner in the middle than at the edge

The most elementary forms of simple lenses and their characteristics. These simple lenses are the basis of all cinematographic optics, various combinations producing the desired results for photography and projection.

The Focal Length of a lens is the value upon which depends the size of the images produced by that lens. Its magnitude can be determined only by comparing the size of a given object with its image as formed by the lens. The distance of the object, unless very great, must also be considered. With far distant objects the size of the image is in direct proportion to the focal length. A lens of 12-inch focal length will produce an image of a distant steeple twice as large as the image formed by a lens of 6-inch focal length. By the same token it follows that a 6-inch motion picture lens will produce an image just three times as large as the image of the usual 2-inch focus lens.

Back Focus is the distance from the focal point to the rear surface of the lens. In the case of very thin lenses this back focus is equal to the focal length, while in the case of lenses of considerable thickness and in combination of lenses, the back focus cannot be relied upon as any indication of the value of the focal length. The focal length of such a lens is equal to the focal length of a thin lens, which gives an image equivalent in size to the one formed by the combination lens, hence the term *Equivalent Focal Length.*

In the majority of photographic lenses the equivalent focal length is greater than the back focus, an exception being found in certain series of lenses where the back focus is longer.

By measuring back from the focal point a distance equal to the equivalent focal length, we find the position of the cardinal point of the lens.

Angle of View is the angle under which the diameter of the circular area covered sharply by the lens appears from the center of the lens (the point where the rays cross). If the largest plate which the lens covers sharply, is used, the angle of view is equal to the angle under which the diagonal of the plate appears from the center of the lens. The angle of view *increases* with the *decrease* of the focus of the lens for the *same sized plate.* Lenses for general purposes are calculated for an angle of about 60 deg. Lenses covering from 50 deg. to 100 deg. are termed *Wide Angle Lenses.* Wide angle lenses have necessarily shorter foci than other lenses rated for the same plate. The usual motion picture lens has an angle of vision of 60 deg.

The circular area which is covered by the lens on the ground glass is called its *Image Circle,* and its diameter is expressed in linear measure (inches or centimeters).

Effective Aperture is measured by the diameter of the beam of light transmitted by the lens. The effective aperture is not, as often thought, equal to the diameter of the front lens, nor is it equal to the linear diameter of the diaphragm opening used. It equals the diameter of the diaphragm as it appears when observed through the front lens; therefore, the effective aperture cannot be found by unscrewing the front lens and measuring the actual diameter of the diaphragm. Only in the case of a landscape lens, where the diaphragm is placed in front of the lens, is the effective aperture expressed by the linear diameter of the diaphragm. The effective aperture varies,

of course with the size of the diaphragm opening.

Relative Aperture is a fraction which expresses the ratio of effective aperture to focal length; for instance, relative aperture of 1:6.3 means that the focal length is 6.3 times greater than the effective aperture. The denominator of the fraction, in this instance the figure 6.3, is called the *F value.* If the relative aperture is known, the effective aperture can be found by multiplying the relative aperture by the focus. For example: F:160; relative aperture 1:8; effective aperture = 160 x 1:8 = 20. The relative aperture is a term of greatest value and convenience in judging the time of exposure. All lenses of the same relative aperture, no matter what their focus may be, require the same exposure under the same general conditions. An exception will be mentioned under the heading "Depth of Focus."

The exposure necessary for different relative apertures can easily be found because they are proportionate to the square of the F values. For instance, if two lenses are compared with the relative apertures of 1:4 and 1:8 respectively, the squares of the F values are 16 and 64 respectively, which means that the 1:8 requires four times as long exposure as the 1:4 lens, since 64/16 = 4. This, of course, also holds true in comparing the different stops.

Speed: The relative aperture is very commonly called the speed of the lens, although the speed of two lenses is not proportionate to their relative apertures but to their squares. In other words, a lens with the speed of 1:4 is not twice as fast as a lens with the speed of 1:8, but four times so, as the comparison

of the squares of their relative apertures 1/16 and 1/64 shows.

There are two methods of designating lens stops, viz.: The so-called *F System* of the Royal Photographic Society, wherein the stop is expressed by fractions of the focal length, and the *U. S. (Uniform System)*, in which every following stop requires a doubling of the exposure or represents half the speed of the foregoing, the exposure required with F:4 being taken as the unit.

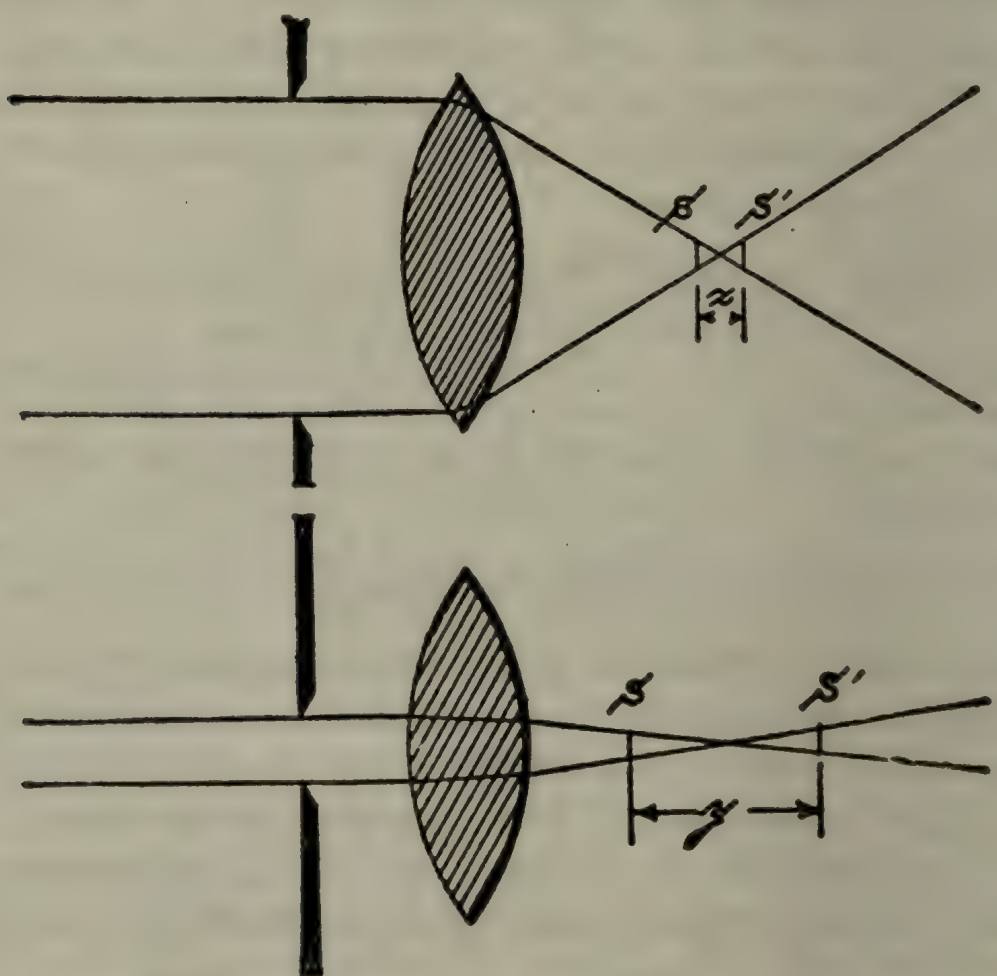
COMPARISON BETWEEN THE F SYSTEM AND THE U. S. (UNIFORM SYSTEM) OF STOPS

F System									
F:4	F:4.5	F:5.6	F:6.3	F:8	F:11.3	F:16	F:22.6	F:32	F:64
U.S. System									
1	1.2	2	2.5	4	8	16	32	64	128

The foregoing table gives the comparative stops in the two systems and shows at the same time the exposure values of the different stops in the F system. For instance, F:11.3 requires four times as long an exposure as F:5.6; and F:32, an exposure sixteen times longer than F:8, since $8/2 = 4$ and $64/4 = 16$.

Depth of Focus: Very closely connected with the speed of a lens is its depth of focus. All well-corrected lenses image only one plane of the object space sharply. The reason why a lens focused at a house images also with sufficient sharpness, say a horse in front and a tree back of it, lies in the fact that a slight racking out of focus will not cause an indis-

tinctness great enough to be noticeable to the eye. The range of sharpness forward and back of the object is called "depth of focus" or "depth of field." It depends on several factors, viz.: the focal length of the lens, the aperture used (consequently the



A demonstration of depth of focus. Note that the smaller the aperture used, the finer the beam of light, hence the greater the depth of focus. S S^1 represents desired degree of definition, X depth of focus with big aperture, Y with small aperture.

speed), the distance of the object, and the amount of lack of sharpness which seems permissible to the operator. Of these factors, focal length, aperture

and distance are definite numerical values. That the amount of indistinctness permissible in the picture is susceptible of numerical expression is easily seen from the following: If an object at a given distance is in sharp focus, the light issuing from a point of that object is converged to a point on the plate. Lighting issuing from a point forward or back of the object will also be converged to a point, but not on the plate, the cone of light showing in either case a circular patch on the plate. This circle of light is known as the "circle of confusion." Its diameter can be used to express the amount of indistinctness existing in a picture. If the circle of confusion is not greater than 1/10 mm. or 1/250 inch, it would appear as a point to an eye 10 inches away, hence an object no point of which is imaged by a circle larger than 1/10 mm. would appear sharp.

No matter what their type of construction may be, all lenses of the same equivalent focus and the same relative aperture require the same exposure, that is, have the same speed, other conditions being equal. They will also have the same depth. The depth of focus decreases:

1, With increase of focal length; 2, with increase of relative aperture (speed); 3, with increasing nearness of objects.

Of two lenses of the same equivalent focus, the one with the lower relative aperture (speed) has the greater depth of field. On the other hand: if the focal length of the lens is very short, a speed as high as F:4.5 will allow bringing every object from 10 feet to infinity to a sharp focus, while a studio lens of

long focus and the same speed may not even image an object of the depth of a head sharply within the range of the length of a studio. Speed, great focal length and depth of focus cannot be combined in the same lens. *This is an unalterable law of optics.* If speed be the most desirable quality, depth of focus must be sacrificed; if depth of focus, speed. This does not detract from the value of fast lenses, because with a given lens the depth of focus can be increased by diaphragming down the lens, which means reduction of speed. If a short exposure demands the use of the lens wide open, one must not expect great depth of focus. Under ordinary conditions of light and distance, with fair judgment, and with lenses not too long in focus, these opposing qualities may be happily combined, so that lack of depth is hardly perceptible.

Some apparent exceptions may be stated, for instance, a lens which produces images of general "softness"; *i.e.*, a lens in which the aberrations are not corrected to the utmost perfection. Such lenses, which lack snap and brilliancy, may show greater depth of focus than a first-class lens. There is less difference between the "sharpest" focus and the image of objects forward and back of it, simply because the "sharpest" focus itself is not really sharp. Thus the statement that one lens has a greater depth of focus than others of the same aperture and focus must be regarded as a rather doubtful compliment to the lens, for, as stated above, the depth of focus cannot be made subject to special correction.

Another case may be mentioned in which one lens may really have an advantage over another one, in

regard to depth of focus. In some constructions correction of astigmatism is obtained at a great sacrifice of simplicity by employing an unusual number of lenses separated by air spaces. There is a certain loss of light by reflection on a lens surface and it is intelligible that the fewer the reflecting surfaces in a lens, the smaller the loss of light. In some constructions the number of the lens surfaces runs up as high as ten, while the Tessar contains only six. The consequence is that the lens with the greater number of reflecting surfaces requires a longer exposure than the lens of simple construction, although both may have the same relative aperture.

The usual motion picture lens, with a focal length of two inches and a speed of F:3.5, represents a happy combination of speed with depth of focus. Thus the motion picture lens even when used wide open still permits of obtaining a remarkable depth of focus. By the same sign the motion picture lens when sufficiently cut down, permits of photographing an actor or object moving toward the camera from infinity to within several feet without having to change the focus of the lens, yet without having a blurred image.

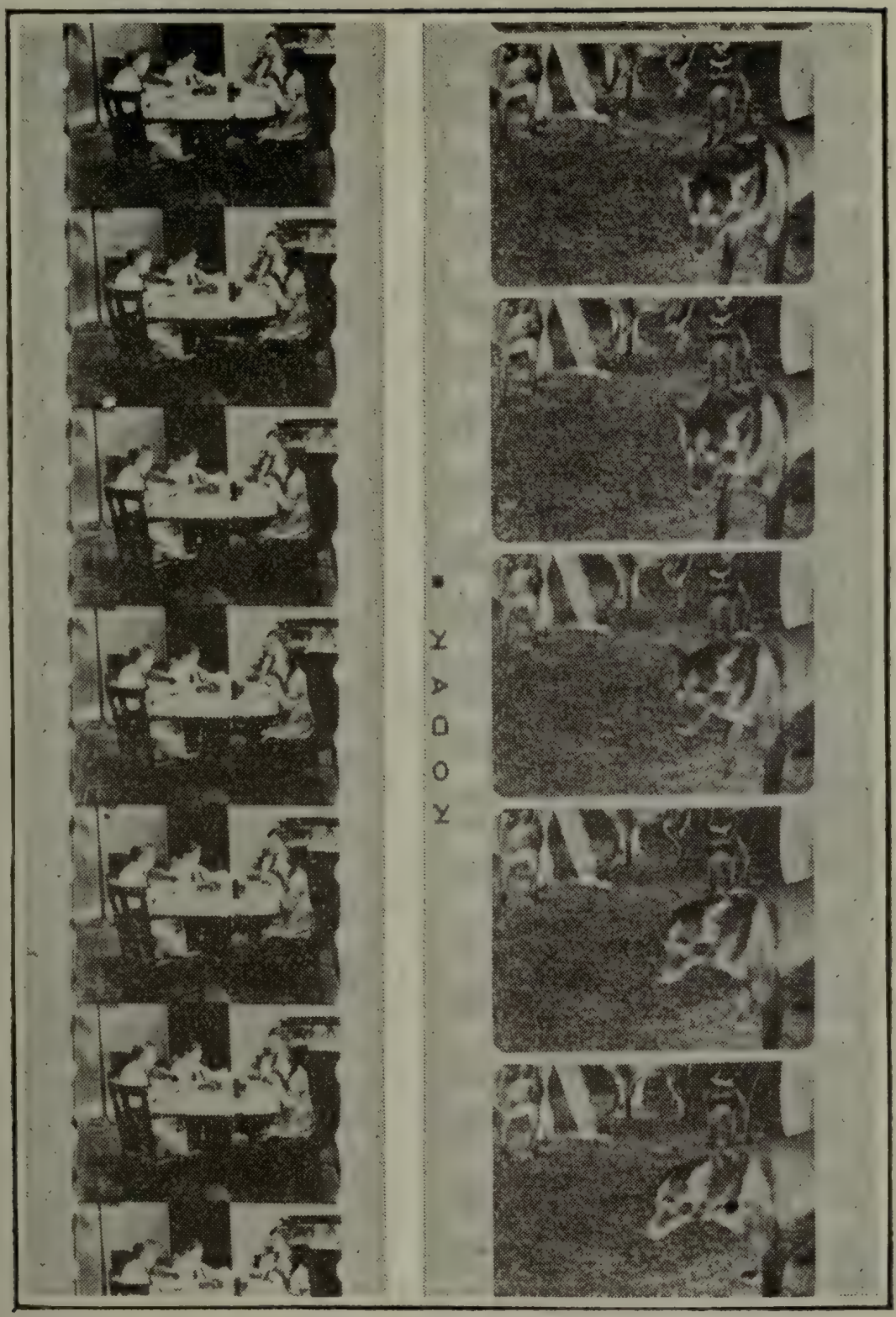
In motion picture work practically all the lenses employed are anastigmat lenses, as differentiated from the simpler rapid rectilinear lenses, which do not render sharp images over the entire field when used wide open.

Illumination: We speak of even illumination when the margin of the plate receives as much light as the center, and when the negative shows an even density

all over. A perfectly even illumination is only possible with small stops, especially when a larger plate is used than the lens is rated for. All speed lenses show more or less drop in the illumination (vignetting) toward the margin of the field covered when used with the full aperture.

The Covering Power is expressed by the area which the evenly illuminated flat field covers with perfect definition. It depends upon the diameter of the lenses and on the degree to which the different aberrations are corrected and may, in some cases, be increased by using smaller stops. The greater the relative aperture and the greater the covering power, the more valuable the lens.

Among the defects to be guarded against in lenses are *Curvature of Field,* which is that undesirable quality that brings a flat object to a focus in a convex field. The consequence is that it becomes impossible to focus a flat object sharply on the plate at the center and at the edges of the field at the same time. *Distortion* is a fault that causes straight lines in the object photographed to be rendered as curved lines in the negative. This distortion is generally noticed only along the edges of a plate, and is characteristic of single achromatic lenses and other cheap lenses. With a single lens back of the diaphragm, lines are bowed out, causing "barrel-shape" distortion; with the lens in front of the diaphragm, the reverse effect, or with lines bent in to cause the "pin-cushion distortion," is obtained. Now then, by placing one lens in front and another back of the diaphragm, these defects are counterbalanced and therefore rectified.



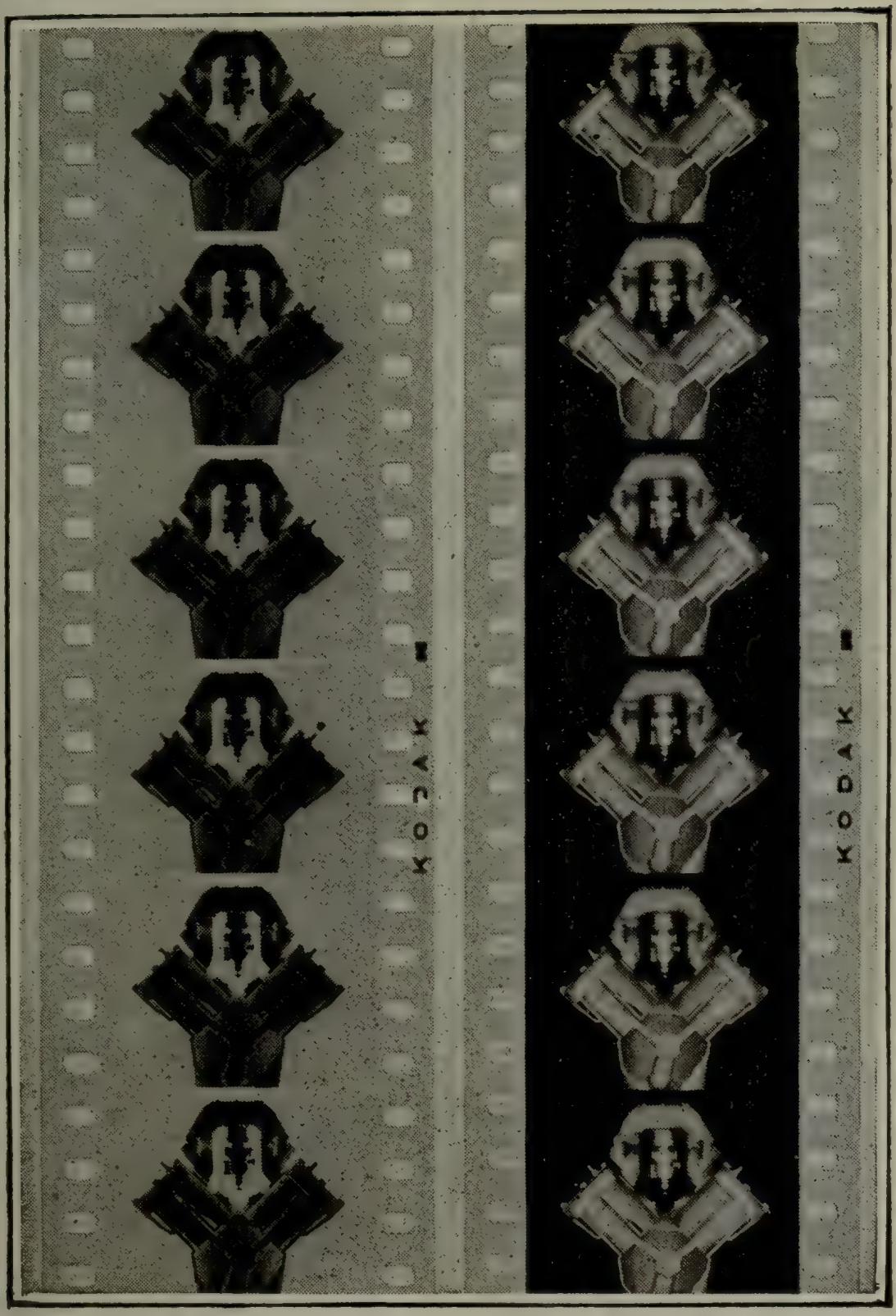
Positive prints for non-professional and standard professional use. The film at left is Safety Standard; the one at the right is the professional standard.

This arrangement, in brief, is the principle of the rapid rectilinear lens.

What Makes Motion Pictures Move?

So much for the principles of photographic lenses and the terms used in speaking and writing about them. The next step is to consider what happens to the rays of light that are gathered by the lens and brought to the negative. In the case of the motion picture camera the negative usually takes the form of a flexible and continuous length of transparent ribbon coated on one side with the photographic emulsion, and provided with a system of perforations for facilitating its handling in the camera or projector. The material employed for this flexible ribbon is generally celluloid for the negative film, and either celluloid or acetate of cellulose, which is practically non-inflammable, for the narrow-width films, both kinds being employed for projection.

The standard film measures one and one-third inches wide, and carries a picture for each four perforations, the vertical position of the picture being longitudinal of the film. The dimensions of standard or professional-sized film are shown in the drawing on page 22. There are sixteen pictures or "frames" to every foot of film. Standard practice calls for the perforations alongside each picture or frame, with the frame line midway between perforations, although some European producers have their frame line even with every fourth perforation. There is the Safety Standard or narrow-width film of acetate of cellulose stock, shown detailed on page 25, intended for use



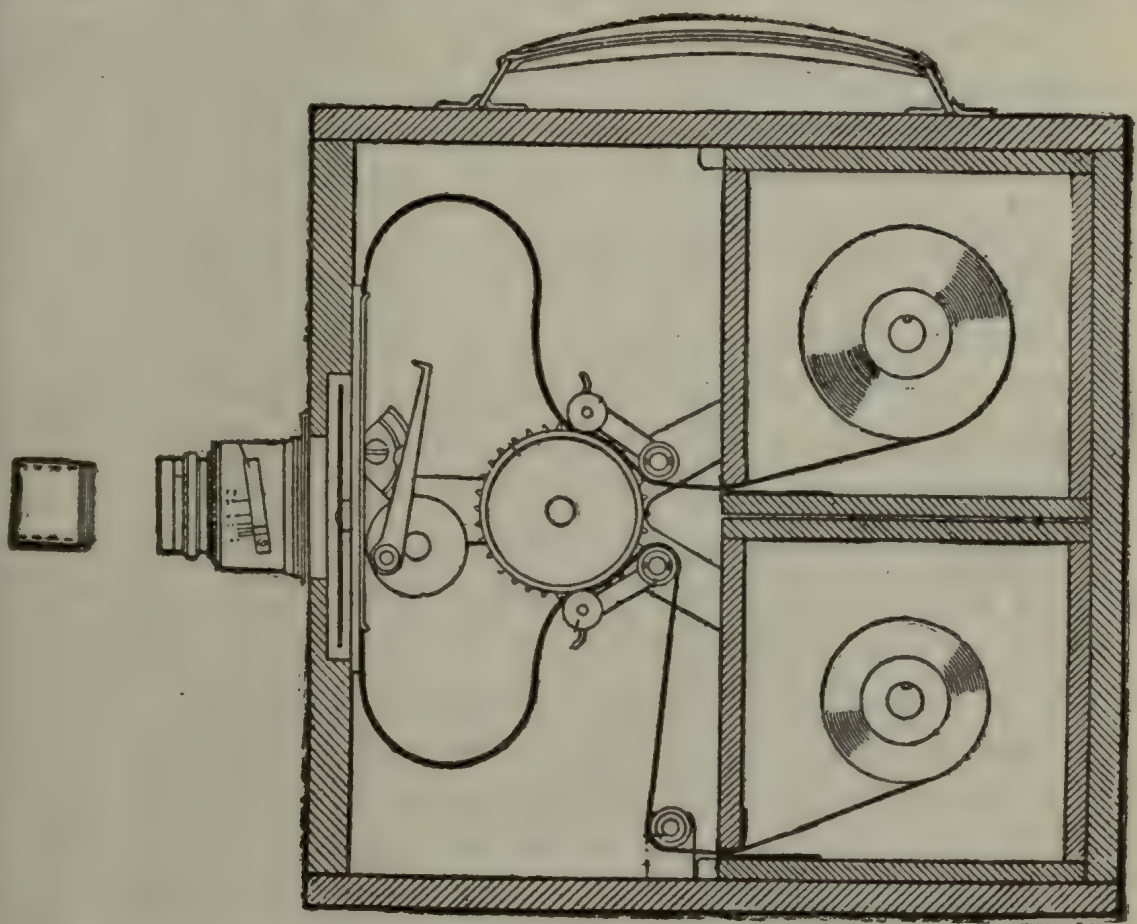
Negative and positive film. The negative is made in the camera while the positive is printed from the negative in the laboratory.

where a non-inflammable film is desirable, and practically the same thing with slightly different perforation arrangements, on page 28, a chapter on both of which will be found further on in this work. Motion picture cameras of the professional types handle 400-foot or 200-foot rolls of negative at one loading, while amateur cameras and semi-professional types, as well as portable cameras for news and travel work, handle 200-foot or 100-foot rolls.

The motion picture camera is nothing more than a special camera taking a series of snapshots, so to speak. The film is exposed by a revolving shutter which has an adjustable opening, so that as the shutter revolves and the opening comes in line with the lens, light passes through and impinges on the sensitized coating of the film. The film, meanwhile, is stationary. However, as soon as the light has been permitted to fall on the film for the required length of time, the shutter, turning continuously all the while, shuts off the light from the film, which is then pulled down the distance of one frame, thus bringing a fresh section of film into position for exposure as the opening of the shutter again comes in line with the lens, and so on. The principle is simple enough; what makes the motion picture so complicated as compared to the usual "still" camera is the mechanism for feeding the film and shifting it along intermittently and between exposures, as well as the "taking up" of the film that has been duly exposed, into a light-proof magazine.

The fresh, unexposed film is contained in one magazine which is light-proof and can be loaded into the

camera in broad daylight, and after passing through the camera mechanism to be exposed, the same film is taken up or rolled up in a second magazine which is also light-proof and can be removed from the camera in broad daylight. The magazines, however, have to be loaded with film in a darkroom, but by



Diagramatic presentation of a motion picture camera. The film travels from the top magazine to the bottom magazine, being exposed just behind the lens.

carrying a number of loaded magazines about, the cameraman is assured of the desired supply of film.

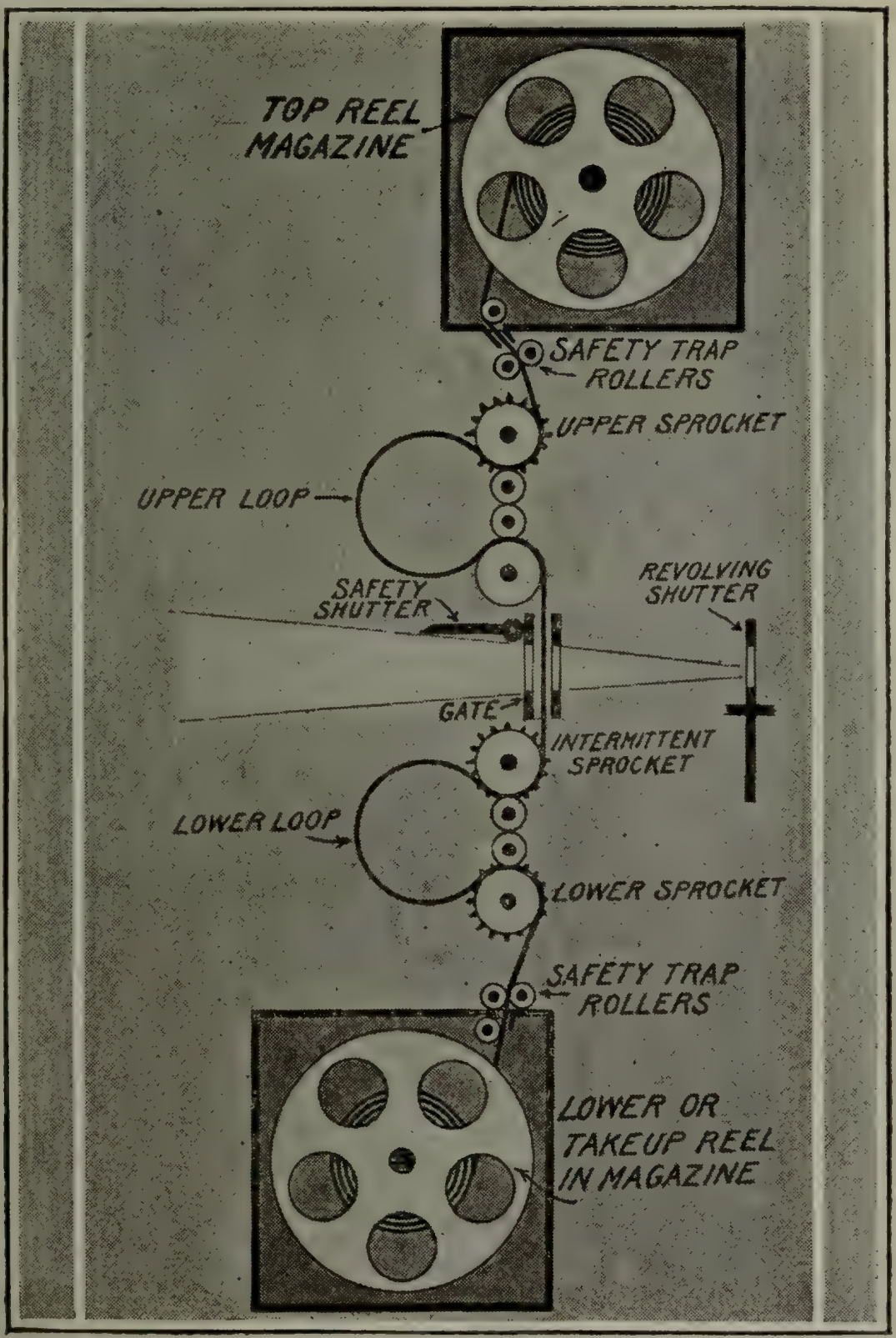
Then again, the motion picture camera is complicated because it must have all kinds of accessories for focusing, measuring the exposed footage, measur-

ing the speed, masking the pictures, and so on. In the latest professional cameras the accessories bulk up as strikingly in proportion to the camera as the accessories of the usual Ford car. There is always something else that must be added, so it seems.

The succession of pictures recorded on the motion picture negative are printed on to a positive film, which is of the same size and perforations as the negative, but is coated with a much slower emulsion. This work of printing is done in a laboratory, as is explained in Chapter X. The positive film is the one that is placed in the projection machine, and by passing light through it—the reverse to the camera principle—the original subject is portrayed on the screen.

The projector is designed very much along the same general lines as the camera, except that the details are necessarily altered to suit the specific requirements of projection. Thus the intermittent movement is of a different type, the lenses are larger, the magazines are considerably larger, handling many times as many feet of film as the camera, and so on. But the principle remains the same, namely, that light passing through the stationary film is permitted to reach the screen intermittently by means of a continuously revolving shutter, while the film is pulled down one image at a time as the light is cut off from the screen.

Now the human eye is by no means as fast to detect motion as it might be, so that anything faster than one-twelfth of a second cannot be detected. This is the principle on which the sleight-of-hand performer, with his nimble hands, depends. And the same may



Diagramatic presentation of a projector. The film travels from the top fire-proof magazine through the "head," and thence to the bottom fire-proof magazine.

be said for motion pictures, since the pictures, thrown on the screen at the rate of sixteen per second, are no longer made out as separate pictures by the human eye, but appear as one continuous picture. The persistence of vision of the human eye is such that it is impossible to detect the jump from one image to the next at that rate of speed, but the eye does detect the changing position of the objects, which then appear as continuous action. As projection is slowed up the eye detects the separate images of the film and the flicker.

Motion Picture Nomenclature

Cinematography, like any of the highly specialized arts, has its language, and it is but proper that we should start out with some knowledge of this language, or nomenclature, in order to understand the technical verbiage in the chapters that follow. Hence the author made use of the splendid collection of motion picture nomenclature prepared by the Nomenclature Committee and adopted by the Society of Motion Picture Engineers, as follows:

ACTION—The director's command to the players to begin performing.

BACK FOCUS—Properly called working distance.

BUSINESS—Action by the player; *e.g.*, business of shutting door.

BUST—A small, magnified part of a large scene.

CAMERA—An expression used to command the photographer to begin taking the scene.

CHANGE OVER—The stopping of one projecting machine and the simultaneous starting of a second

machine in order to maintain an uninterrupted picture on the screen when showing a multiple-reel story.

CINE—A prefix used in descriptions of the motion-picture art or apparatus.

CLOSE-UP—Scene or action taken with the character close to the camera.

CONDENSERS—The lens combination which deflects the divergent rays of the luminant into the objective.

Collector Lens—The lens next to the source of light.

Converging Lens—The lens nearest the objective.

Middle Lens—Of a three-lens combination, the lens lying between the collector lens and the converging lens.

CUTTING—Editing a picture by elimination of useless or unacceptable film.

CUT-BACK—Scenes which are returns to previous action.

CUT-IN—Anything inserted in a scene which breaks its continuity.

DEVELOPING—Making visible the latent image in an exposed film.

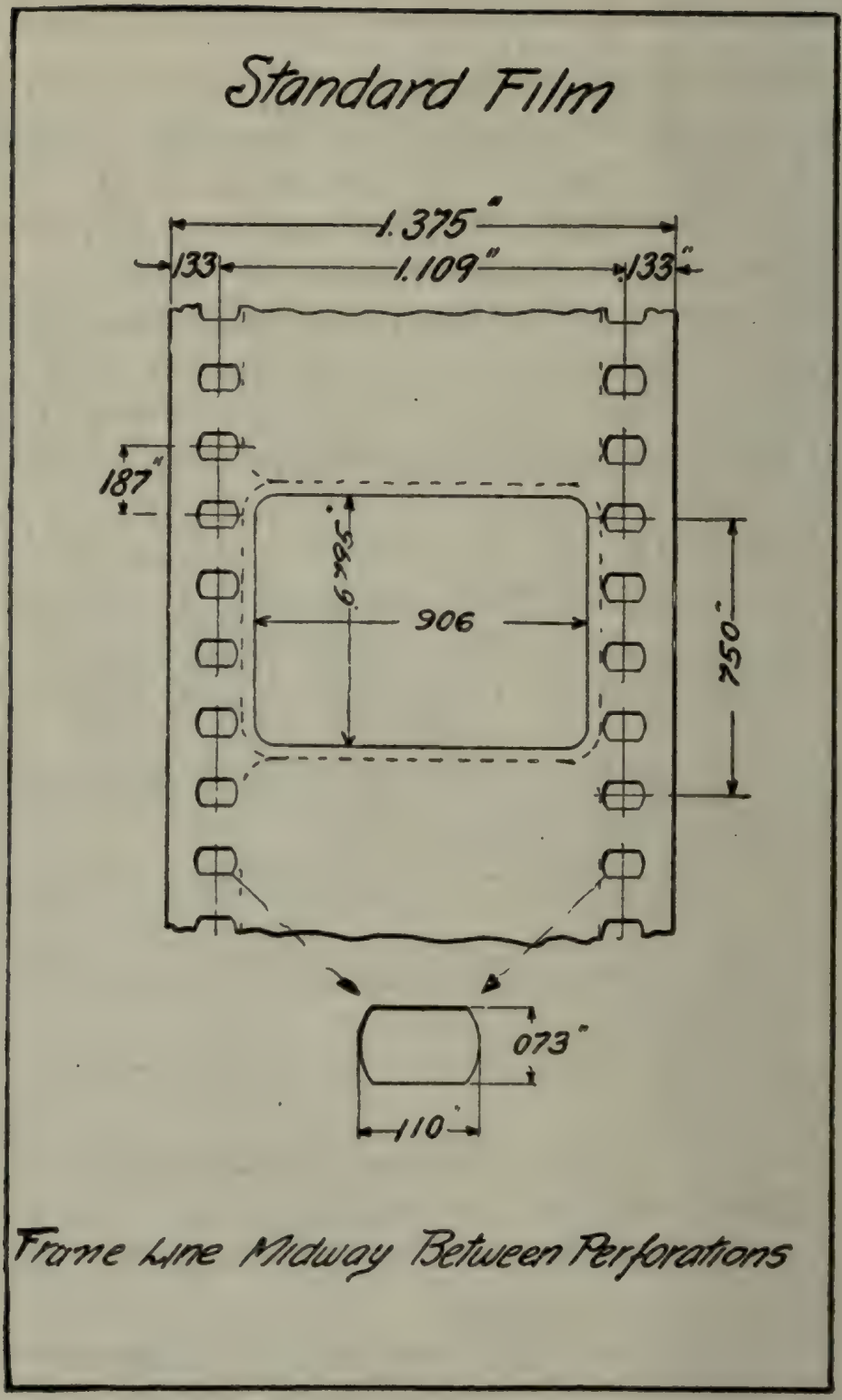
DISSOLVE—The gradual transition of one scene into another.

DIRECTOR—The person who directs the actual production of the photoplay.

DOUBLE EXPOSURE—The exposure of a negative film in a camera twice before development.

DOUBLE PRINTING—The exposure of a sensitive film under two negatives prior to development.

DOUSER—The manually operated door in the project-



Dimensions of the Standard film, which is employed for theatrical and professional purposes. This drawing is actual size.

ing machine which intercepts the light before it reaches the film.

DUPE—A negative made from a positive.

EFFECTIVE APERTURE—The largest diameter of a lens available under the conditions considered.

EQUIVALENT FOCUS—The equivalent focus of a plurality of lenses in combination is the focal length of a simple thin lens which will under all conditions form an image having the same magnification as will the given lens combination.

EXTERIOR—A scene supposed to be taken out of doors.

FADE-IN—The gradual appearance of the picture from darkness to full screen brilliancy.

FADE-OUT—The gradual disappearance of the screen-picture into blackness. (The reverse of fade-in.)

FEATURE—A pictured story, a plurality of reels in length.

FIXING—Making permanent the developed image in a film.

FLAT—A bit of painted canvas, or the like.

FLASH—A short scene, usually not more than three to five feet of film.

FLASH-BACK—A very short cut-back.

FOOTAGE—Film length measured in feet.

FRAME (verb)—To bring a frame into register with the aperture during the period of rest.

FRAME (noun)—A single picture of the series on a motion-picture film.

FRAME-LINE—The dividing line between two frames.

INTERMITTENT SPROCKET—The sprocket which engages the film to give it intermittent movement at the picture aperture.

IRIS—An adjustable lens diaphragm

IRISING—Gradually narrowing the field of vision by a mechanical device on the camera.

INSERT—Any photographic matter, without action, in the film.

INTERIOR—Any scene supposed to be taken inside a building.

JOINING—Splicing into a continuous strip (usually 1,000 feet) the separate scenes, titles, etc., of a picture.

LANTERN PICTURE—A still picture projected on a screen by means of an optical lantern or stereopticon.

LANTERN SLIDE (see slide)—The transparent picture from which a lantern picture is projected.

LEADERS—That piece of blank film attached to the beginning of the picture series.

LIGHT BEAM—A bundle of light rays.

LIGHT RAY—A thin line of light.

LOCATION—Any place selected for the action of an outdoor scene.

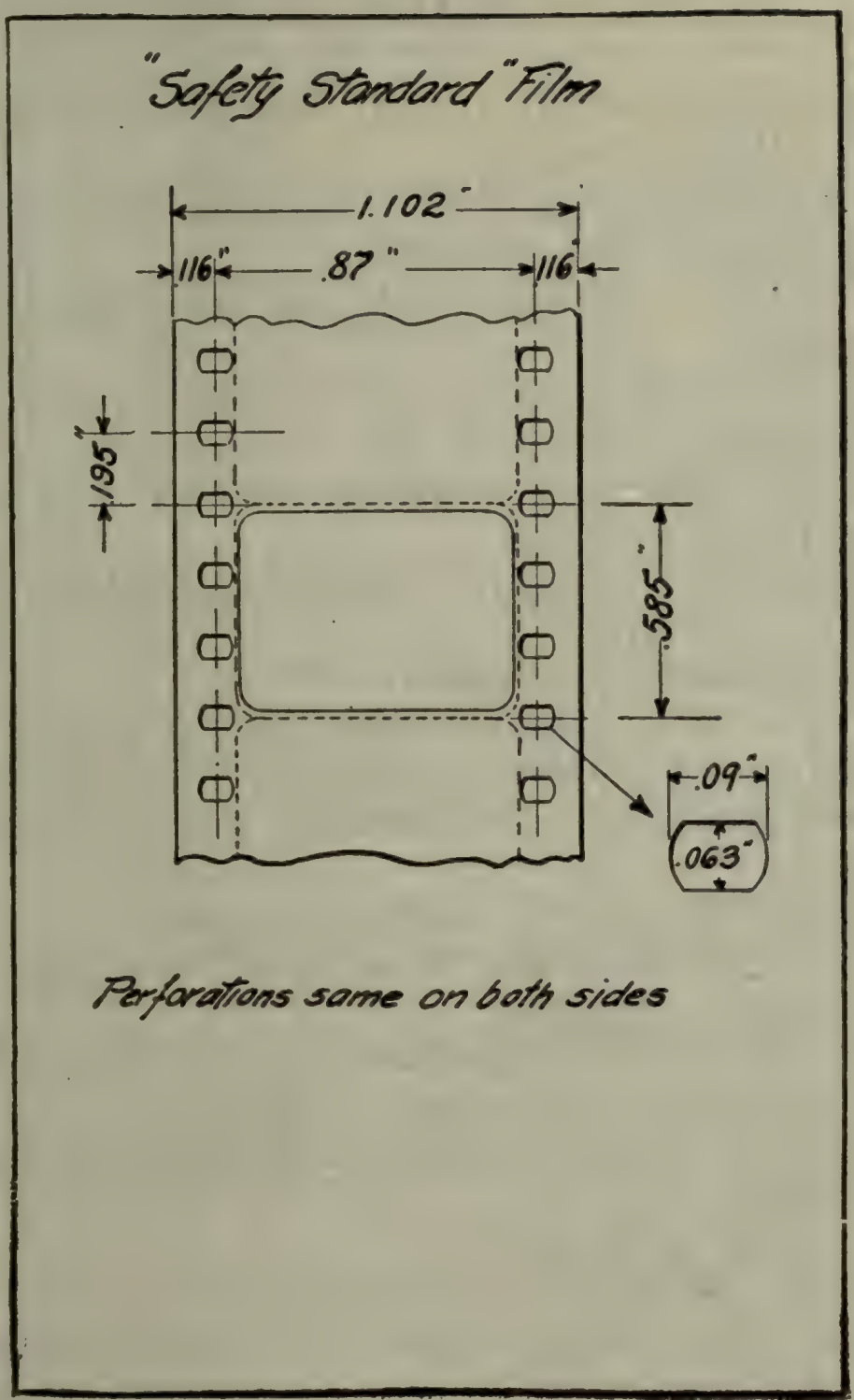
MAGAZINE VALVE—The film opening in the magazine of a motion-picture projector.

MASKS—Opaque plates of various sizes and shapes used in the camera to protect parts of the negative from exposure.

MOTION-PICTURE—The synthesis of a series of related picture elements, usually of an object in motion.

MOTION-PICTURE FILM—The ribbon upon which the series of related picture elements is recorded.

MOTION-PICTURE PROJECTOR — An optical lantern equipped with mechanisms for suitably moving



Dimensions of "Safety Standard" film, which is always made of a slow-burning or fireproof stock, and approved for non-professional use anywhere and by anyone.

motion-picture film across the projected light.

MOVIES—Motion pictures.

MULTIPLE-REEL—A photoplay of more than a thousand feet of film in length.

NEGATIVE—The developed film, after being exposed in a camera.

NEGATIVE STOCK—Light sensitive film intended for motion-picture camera use.

OBJECTIVE—The picture-forming member (lens) of the optical system.

OPTIENCE—A collection of persons assembled to see motion pictures.

PAM—Contraction for panorama.

PANORAM—The act of, or device for, turning a motion-picture camera horizontally, to photograph a moving object, or to embrace a wide angle of view.

PHOTOPLAY—A story in motion pictures.

POSITIVE—The developed film, after being printed through a negative.

POSITIVE STOCK—The light-sensitive film intended to be printed upon through a negative.

PRE-RELEASE—A picture not yet released for public showing.

PRINT—Same as "positive."

PRODUCER—The maker of photoplays.

PROGRAM—The complete show for a single optience.

PROPS—Contraction of properties. Objects used as accessories in a play.

PROJECTION DISTANCE—The distance between the objective and the screen of a stereopticon lantern or motion-picture projecting machine.

PROJECTING LENS—Properly called projection objective.

PROJECTION OBJECTIVE—The objective which forms an image of the lantern slide or film upon the screen.

REEL—The flanged spool upon which film is wound for use in projecting machines.

REEL—An arbitrary unit of linear measure for film—approximately a thousand feet.

REGISTER—A term denoting facial expression of emotions.

RELEASE—The publication of a photoplay.

RETAKE—Rephotographing a scene.

REWIND—The process of reversing the winding of a film, usually so that the end to be first projected shall lie on the outside of the roll.

REWINDER—The mechanism by which rewinding is accomplished.

SCENE—The action taken at a single camera setting.

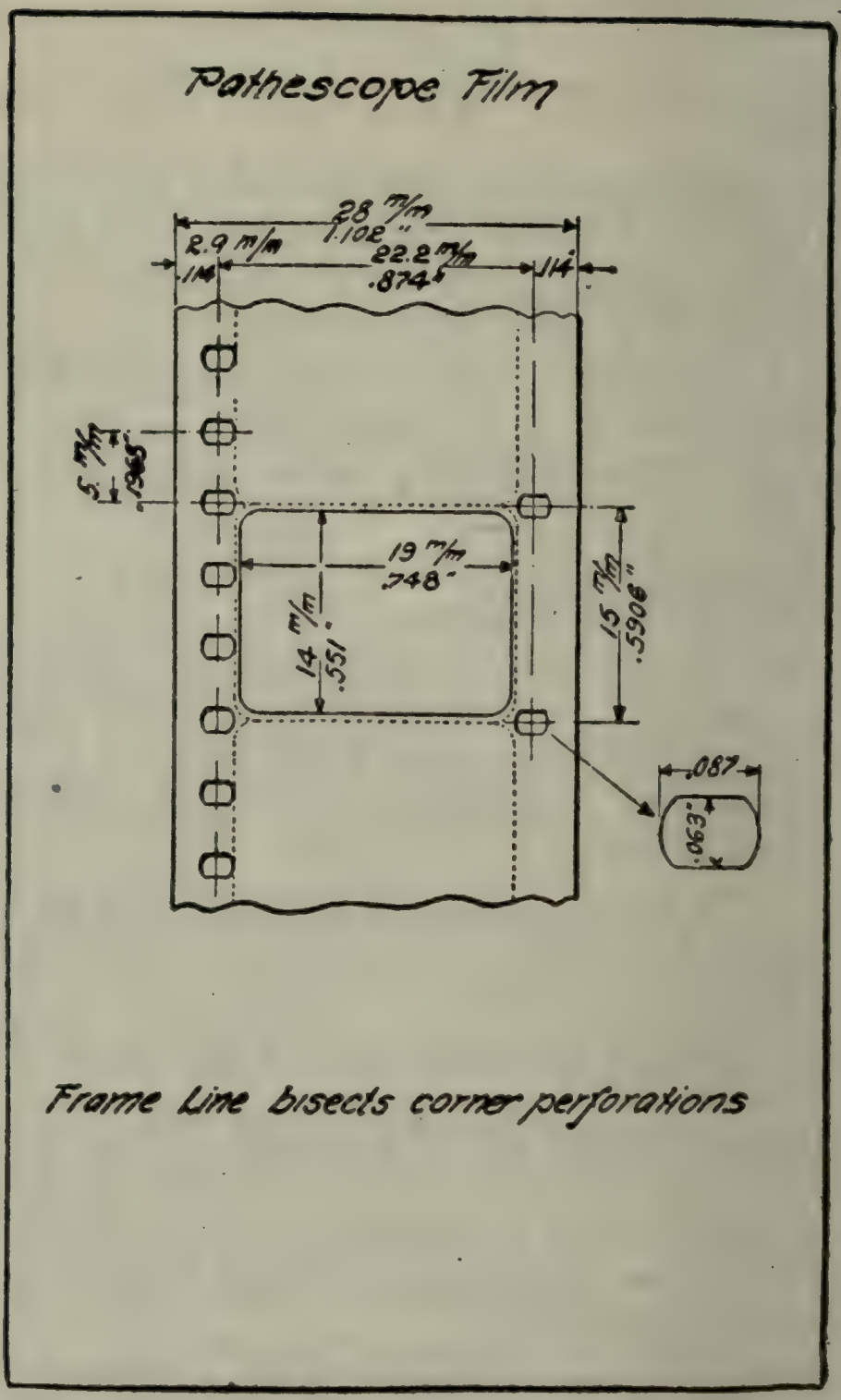
SCENARIO—A general description of the action of a proposed photoplay.

SCREEN—The surface upon which a picture is optically projected.

SHOOTING A SCENE—Photographing the scene.

SHUTTER—The obscuring device, usually a revolving segmental disc, employed to intercept the light during the movement of the film in motion-picture apparatus.

Shutter—Working blade—(also variously known as the cutting blade, obscuring blade, main blade, master blade or travel blade). The segment which intercepts the light during the movement of the film at the picture aperture.



Dimensions of the Pathescope film, which, like the "Safety Standard," is made of a slow-burning material. This film is interchangeable with the "Safety Standard."

Shutter—Intercepting blade—(also known as the flicker blade). That segment which intercepts the light one or more times during the rest or projection period of the film to eliminate flicker.

SINGLE PICTURE CRANK (sometimes referred to as trick spindle)—That spindle and crank on a motion-picture camera which makes one exposure at each complete revolution.

SLIDE (Stereo slide)—The transparent picture from which a screen still is projected.

SPLICING—Joining the ends of film by cementing.

SPLIT REEL—A reel having two or more picture subjects thereon.

SPOT—The illuminated area on the aperture plate of a motion-picture projector.

SPROCKET—The revolvable toothed member which engages the perforations in the film.

STEREOPTICON—A lantern for projecting transparent pictures, *i.e.*, lantern slides, often a double lantern for dissolving.

STILL—A picture from a single negative.

TAKE-UP (noun)—The mechanism which receives and winds the film after it passes the picture aperture.

TAKE-UP (verb)—Winding up the film after it passes the picture aperture.

THROW—Projection distance.

TILT—The act of, or device for, moving a camera vertically while in use.

TINTING—Coloring a film by dyeing the gelatine side of it.

TONING—Coloring a film by chemical action on the silver image.

TRICK CRANK—A camera crank giving a single exposure for each turn.

TRICK-PICTURE—A picture in which unnatural action appears.

TRAILER—That piece of blank film attached to the end of a picture series.

VISION—A new subject introduced into the main picture, by the gradual fading-in and fading-out of the new subject, as, for example, to visualize a thought.

WORKING DISTANCE—The distance from the principal focus of a lens to its nearest face; *e.g.*, the distance from the slide or film to the nearest lens of the objective.

Chapter II.

SELECTING THE PROPER TYPE OF CAMERA FOR THE JOB

IT goes without saying that the camera is the very keystone of the motion picture structure. It is the starting point, for there can be no motion pictures unless there is a camera to record them.

Of late years there has been a steadily expanding variety of motion pictures as compared with a few years back, when the barrier of basic patents on film-shifting mechanisms, backed up by a powerful organization, limited the production of motion pictures to but a chosen few. In those early days it was virtually a crime for an unlicensed person to attempt to make motion pictures, hence there was no need for many different makes of motion picture cameras.

But with the smashing of this monopolistic grip on the young industry and the universal demand for cameras by professional and non-professional workers alike, there has been a steady increase in the number of offerings until today, when one is truly puzzled as to what camera to select from among the bewildering array.

Elements of Inexpensive Construction

There can be no such thing as a really cheap motion picture camera. The mechanism of such a camera

is bound to be intricate, for it must be capable of passing a film through the optical system at the rate of sixteen pictures per second, not in a continuous movement, but in an intermittent movement.

As will be noted in the diagram on page 17 of a simple motion picture camera, it consists of a lens, an intermittent movement for shifting the film through the optical system, a revolving shutter, a continuous movement for bringing the film to the intermittent movement and then taking it away therefrom, and two light-proof magazines for facilitating the daylight loading of the camera. The operation is quite simple. As the crank is turned, the main sprocket engages with the film's perforation and pulls it out of the top magazine in which the film has been placed, and delivers it by means of a loop to the intermittent mechanism. This mechanism consists of tiny claws operated by any one of a variety of movements, depending on the type of camera. At any rate, the claws are caused to engage with the film sprocket holes or perforations, move downward for the space of one frame or image, disengage the sprocket holes, and, moving freely, swing up and again engage with new perforations so as once more to bring down the film one frame, and so on. Passing out of the intermittent mechanism, the film forms a second loop and goes on to the continuous sprocket, which picks up the film as fast as it is passed out by the intermittent movement, and on to the lower magazine, known as the take-up magazine. The lower magazine is power driven in this case, in order to pull

in the film after it has passed the continuous sprocket. In some cameras a belt drive is employed; in others a train of carefully meshed gears.

The upper loop and lower loop play an important rôle in all motion picture apparatus, for it is by means of these simple devices that it becomes possible to couple up the continuous and intermittent movements. Thus the continuous movement feeds film continuously into the upper loop, while the intermittent movement, keeping in step, takes out as much at each engagement as the continuous movement has fed into the loop in the same period. Similarly, the intermittent movement feeds as much into the lower loop at one engagement as the continuous movement takes out in the same period. Hence the loops permit of compensating for the difference between continuous and intermittent movements. Simple? Yes; but this simple idea was the basis of a patent structure which gave one organization a monopolistic grip on the entire motion picture industry in the United States, and it required years to break that grip and make the motion picture field an open one for everybody.

The operation of the motion picture camera is simple. As the crank is turned, it drives the continuous movement, which may consist of one or more sprockets, the intermittent movement, and the take-up magazine, not to speak of the revolving shutter. When the film remains stationary in the little frame or gate which is in line with the lens, the revolving shutter, which is a disk with an opening in the form of a V cut or sector that may be made larger or

smaller, according to the desired exposure, has its open portion in line with the lens so as to permit the rays of light to pass through to the film, thus making the exposure. The shutter, revolving all the while, brings its solid or opaque section into line with the lens, shutting off the light; whereupon the intermit-

The Bell & Howell camera at left, and the Pathé No. 1 or studio model at right.

tent mechanism shifts the film along for the space of one image, bringing a fresh section into line. The shutter, still turning all the while, brings its open section into line with the lens, thus permitting the rays once more to pass through and fall on the fresh section, making a second exposure, and so on.

A Question of Transmission

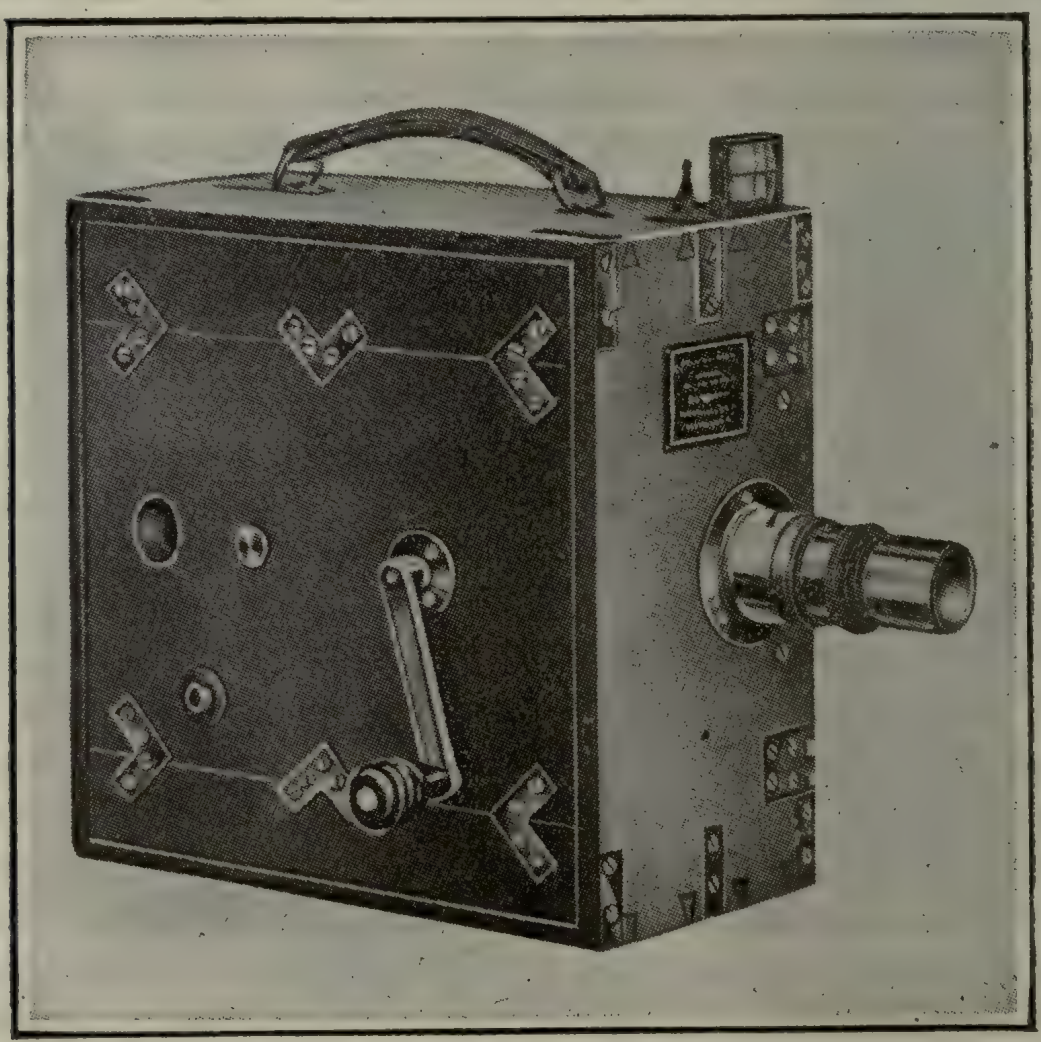
Now the continuous mechanism, consisting of one or two sprockets, the intermittent movement and the shutter must all be interconnected so that they will function as a unit. This may be accomplished by different methods of transmission, such as gears, chain drive, spring-belt drive, or any combination of such drives. And it is generally in the matter of the drive that the mechanism of the inexpensive camera differs most from the expensive cameras, let alone the more obvious differences of finish and completeness of equipment.

There are inexpensive cameras in which the intermittent movement is quite excellent, but the transmission system consists of poorly meshed cast iron gears and troublesome belts that must forever be tightened. There is considerable play in cast gears, especially the cast-iron variety, and such cameras are apt to be unduly noisy and anything but precise in their work. However, where the filming need not be of the very best, such cameras may do. In fact, for such work as animated cartoons and animated models, where pictures are taken one at a time by means of the trick- or single-picture movement, even these cheap cameras are often quite satisfactory, whereas they would prove an unfortunate choice for the usual run of work.

Thus it is obvious that where the work permits, an inexpensive camera may be purchased because the highest precision in the machine work involved in good cameras is not necessary.

One element in considering the proper camera to

use for a given job is the footage or capacity of said camera. For the simplest kinds of amateur work, a 100-foot capacity is considered ample. Such footage



A typical inexpensive camera for amateur use. This type is quite favored in England. It takes 100 feet of negative at one loading, and is often used for news or topical work.

permits of making short bits of film which prove quite sufficient for recording the desired action. However, where serious work is to be undertaken, such as indus-

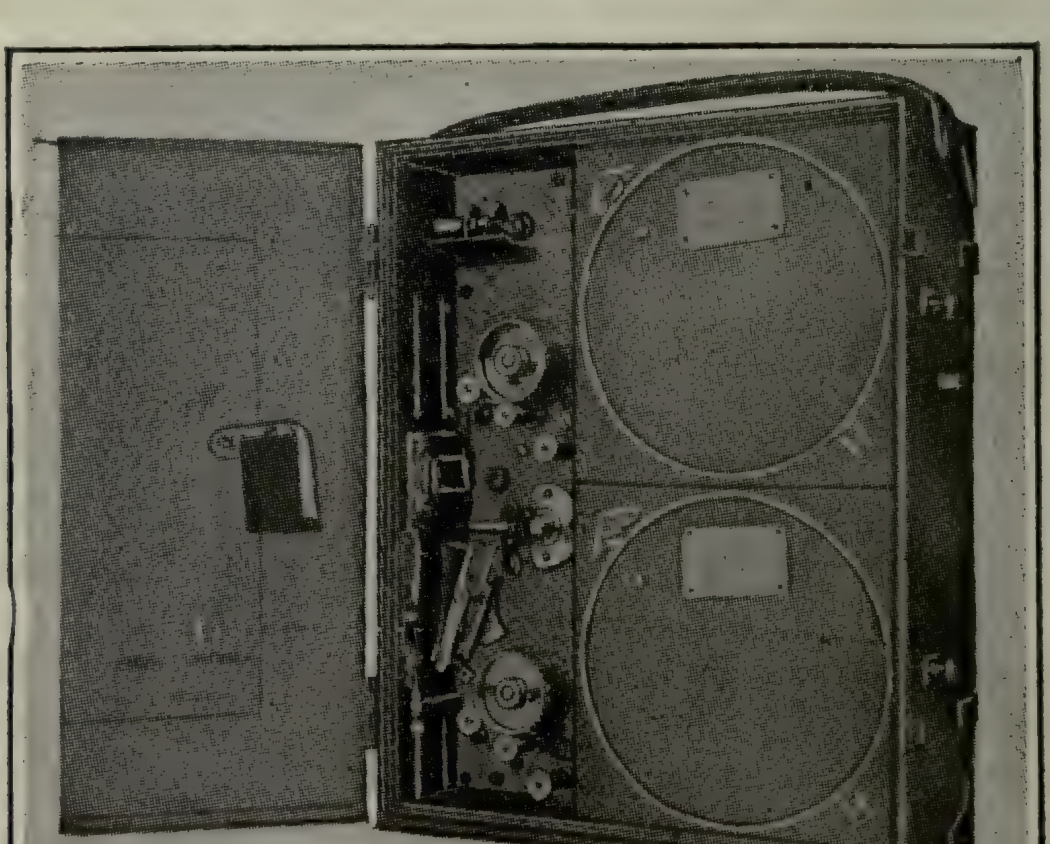
trial, scientific, educational, topical or news work, no camera with a capacity less than 100 feet should be considered; and even 200 feet is apt to prove unfortunate at times. Even with a capacity of 400 feet, which is the standard for all professional cameras, the film has a way about it of running out—being all exposed—right in the middle of some important scene. The not over-careful cameraman, while turning his crank and watching intently the scene being filmed, is often apt to find the crank suddenly turning easily and free, with its film load released because the film has run out. Of course, there is an indicator on the camera, which indicates the footage exposed and the footage still unexposed; but one cannot tell, on occasion, when a scene is going to end, with the result that one starts with 10, 20 or more feet left to go, only to discover that the scene required more footage than was still available. Obviously, with a 400-foot magazine there is an end to the film every four hundred feet, whereas with the 200-foot magazine there are two ends—two opportunities for running out of film—for every four hundred feet.

What to Look For and Why

So much for the drive or transmission, and the capacity. In this discussion we are dealing only with cameras employing standard-sized motion picture negative, and are not taking into consideration the Safety Standard, Pathescope, and other narrow-width non-theatrical sized films, which have their own special cameras.

A motion picture camera to be of any use must have

a finder, which may be of the brilliant type with a simple rectangular lens through which the subject may be sighted, or a miniature camera type of finder, with a lens and ground glass. The finder may be mounted on top or on the side of the camera, or



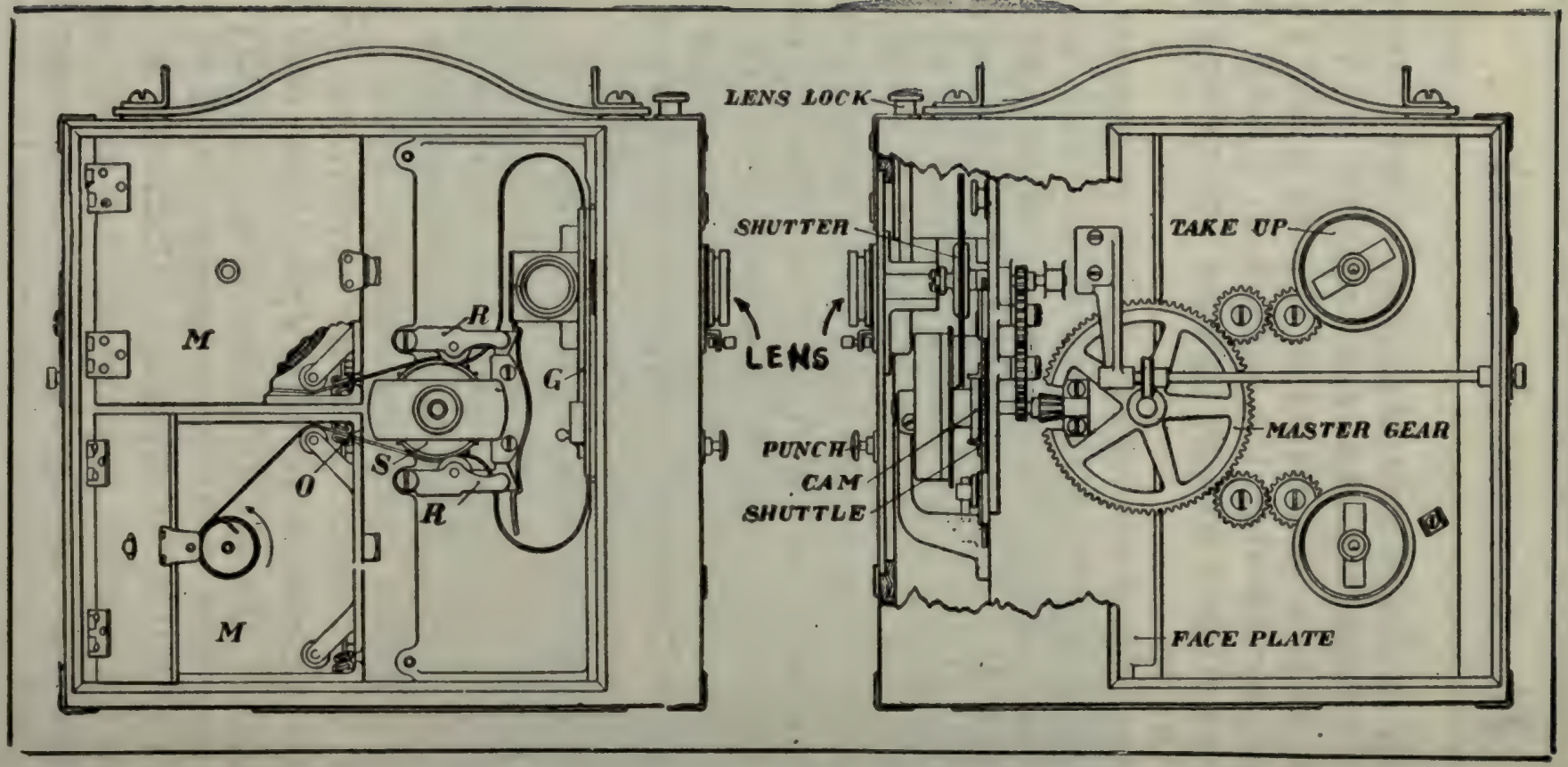
Professional camera of rather inexpensive construction. Note the claw movement and the arrangement of the 400-foot magazines. Also, note the two continuous sprockets which bring and remove the film from the intermittent movement.

arranged to be used in two or more positions for the convenience of the cameraman. No camera can be complete without a finder, and even the most inexpensive cameras have finders either mounted outside

the cabinet, or built into the case. Some cameras, generally of foreign make, are provided with large direct-view finders, consisting of a wire frame and a simple sight for viewing the subject on a large scale vision. Such finders fold up against the camera case when not in use.

Another essential is a footage dial or counter, in order to keep track of the unexposed film in the camera. Some of the cheaper forms of cameras are not provided with such dials, and the cameraman is forced to improvise some means or other of keeping check on the footage exposed and the film remaining to be exposed. This can be done by keeping accurate count of the turns, since every two turns represent one foot of film. The writer, speaking from practical experience with his first inexpensive camera which had no footage indicator, strongly urges against all forms of cameras which have no such device.

Still another essential is daylight loading. Cameras have been developed for amateur and semi-professional use in which no magazines are used. Instead, negative stock is supplied by the manufacturer in the form of large metal spools containing the film which terminates in a length of black perforated paper. Indeed, this scheme is identical with the roll film camera in that the cartridge or spool protects the film from daylight until it is safely placed in the camera and unrolled for exposure. Such spools, be it understood, are special, and specials are often apt to prove inconvenient in filming operations, especially those far afield. It is always better to use the regular magazines or film retorts, holding the desired amount



Details of the Universal camera. M M represents the two magazines. R R are the idlers, which hold the film in place on the master sprocket S. The gate, where the film is exposed to the light from the lens, is at G. The left-hand drawing shows the film side of the camera, and the other drawing represents the other side, which contains the driving mechanism.

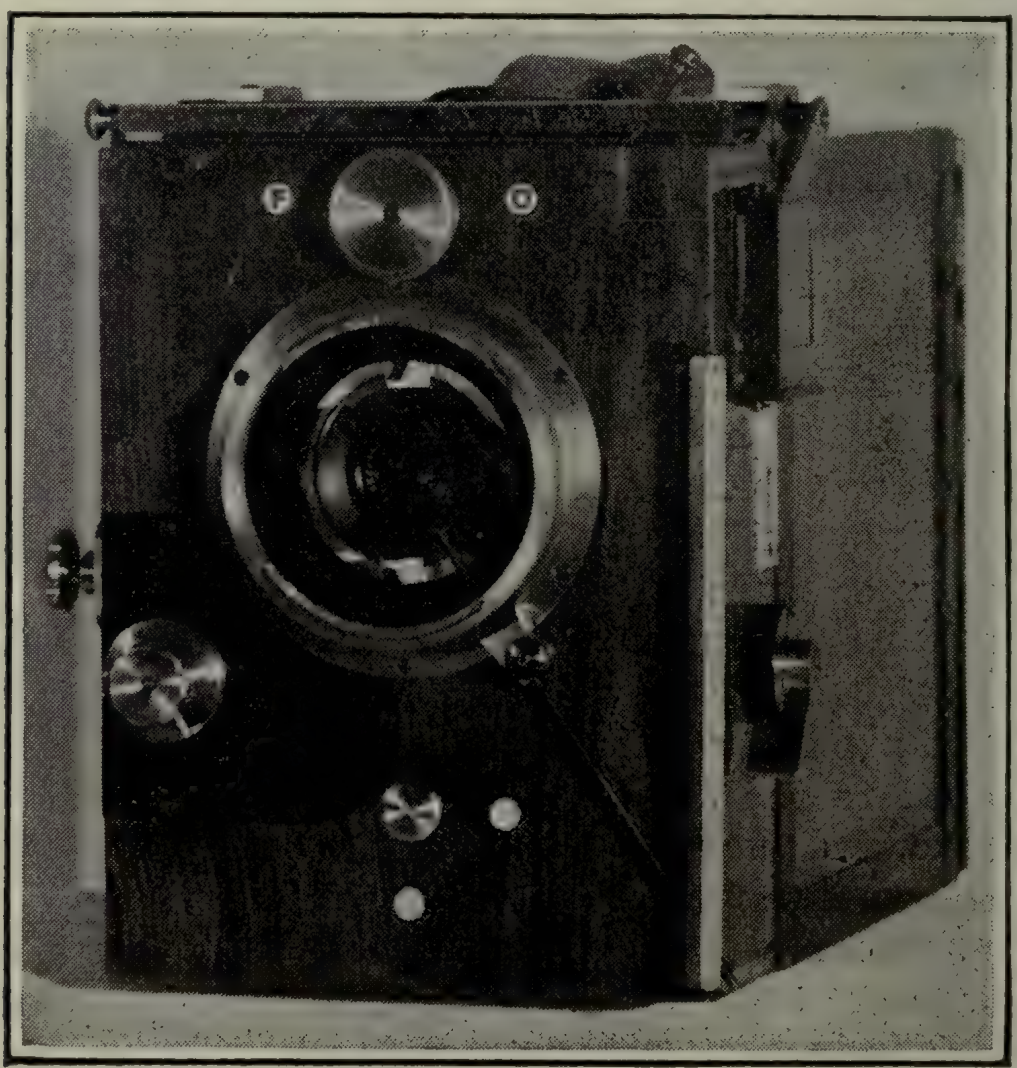
of film. These magazines are loaded with film in the dark room, and can then be handled in the broad daylight. The camera can be loaded with one magazine, while an empty magazine is placed in the camera for taking up the film that is being exposed. When the filming is completed, the camera case is opened and the exposed film, safely rolled up in the take-up magazine, may then be removed in the daylight. A fresh magazine is now placed in the camera, and the magazine that has just been emptied of its film may be shifted to the take-up position, there to perform its new functions. Meanwhile the magazine containing the exposed film is safely put away until the darkroom is reached, where it is opened and the exposed film removed either for immediate development or for storage in some other safe container, such as a film can, so as to release the camera magazine.

It must be obvious that in threading a camera, that is, passing the free end of the film through the sprockets and intermittent mechanism, whatever film is exposed to the daylight must be ruined. This is quite true, and the usual camera calls for the wastage of three to five feet of film to thread it properly. Here again it becomes obvious that in the case of the 400-foot capacity camera, the wastage from threading is just one-half what it is with the 200-foot camera, and one-quarter what it is with the 100-foot amateur cameras.

Deciding Between Fancy and Plain Photography

Where the matter of cost comes in is largely in the additional features of a camera. Thus the camera

available for straight filming, without the numerous accessories and fittings required for the elaborate photographic effects now featured in practically every photoplay, may be obtained at a reasonable price.

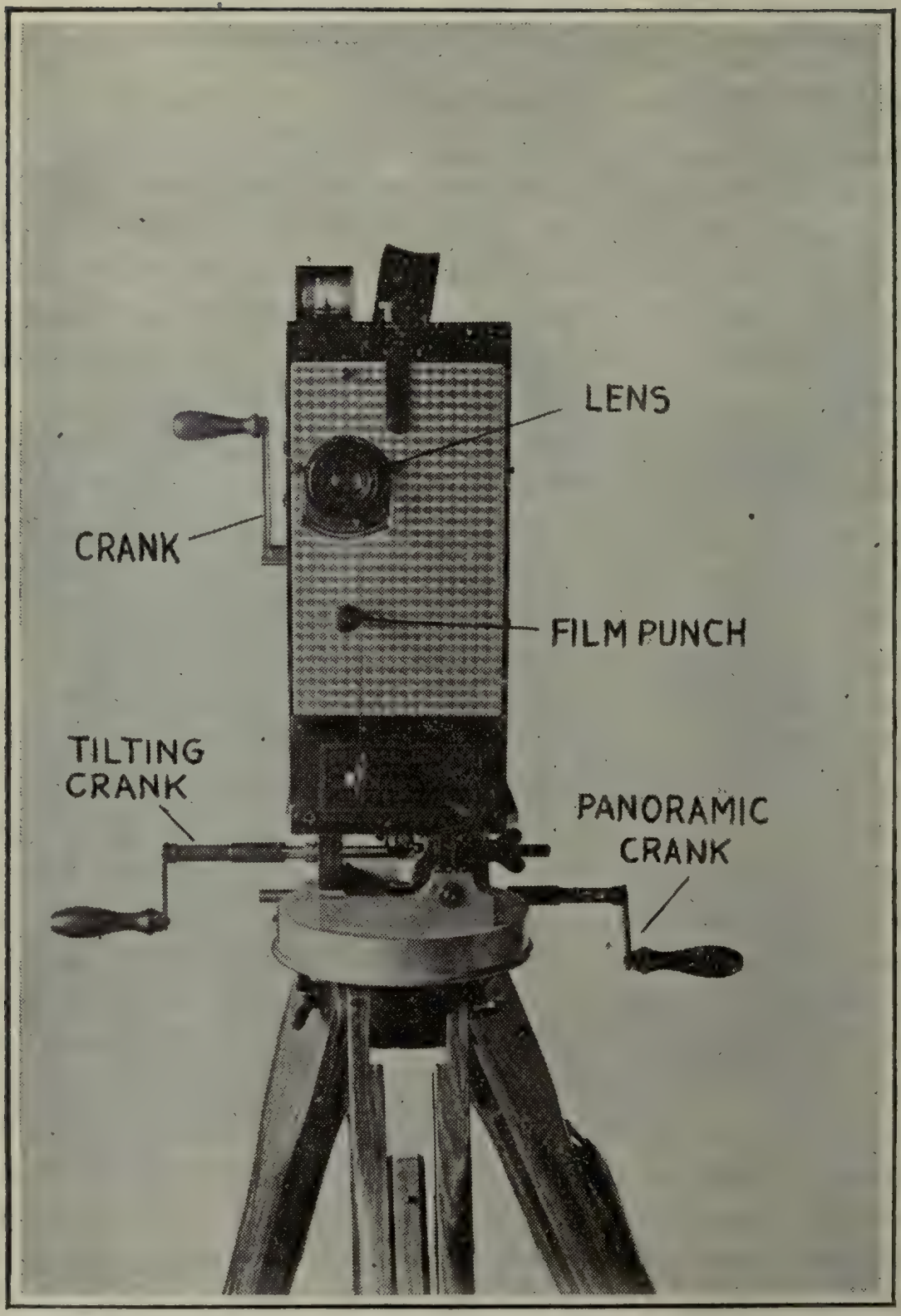


Front view of the Debrie camera. The square rods at the right and top indicate the focus and diaphragm adjustments.

However, the moment the cameraman seeks a camera that can be used for accurate double-exposure work, fade-ins and fade-outs, with a multiplicity of lenses

readily brought into action, with a counter for keeping track of the turns in making double-exposures and split-stage pictures, and so on, the price goes up by leaps and bounds. But straight photography is well within the limits of the amateur cinematographer, whereas elaborate photography is in the professional's field and the equipment is therefore quite costly.

Of the several American, British and German cameras of moderate price—cameras that are thoroughly practical for straight photography, and not to be confounded with the toys or near-toys selling for $100 or less—the most widely employed is the Universal Camera. Through experience and ability on the part of the designer of this American camera, a large number of highly practical features have been worked into its mechanism without complicating it to a point beyond the desirable limits. In fact, this camera combines simplicity with good common sense, and it will do all the work that any other camera, regardless of price, will do in the field of straight photography. It is not intended for studio work, nor for the filming of photoplays, because it does not include the numerous later-day accessories that go to produce the fancy effects now so common on the screen. Nor is it adapted to filming subjects at several times the normal speed, so as to make slow-motion films. For that matter no camera except a special slow-motion camera can be satisfactorily used for such purpose. But for the production of industrial, educational, scientific, advertising, news, screen magazine, and other films of this general class, it is



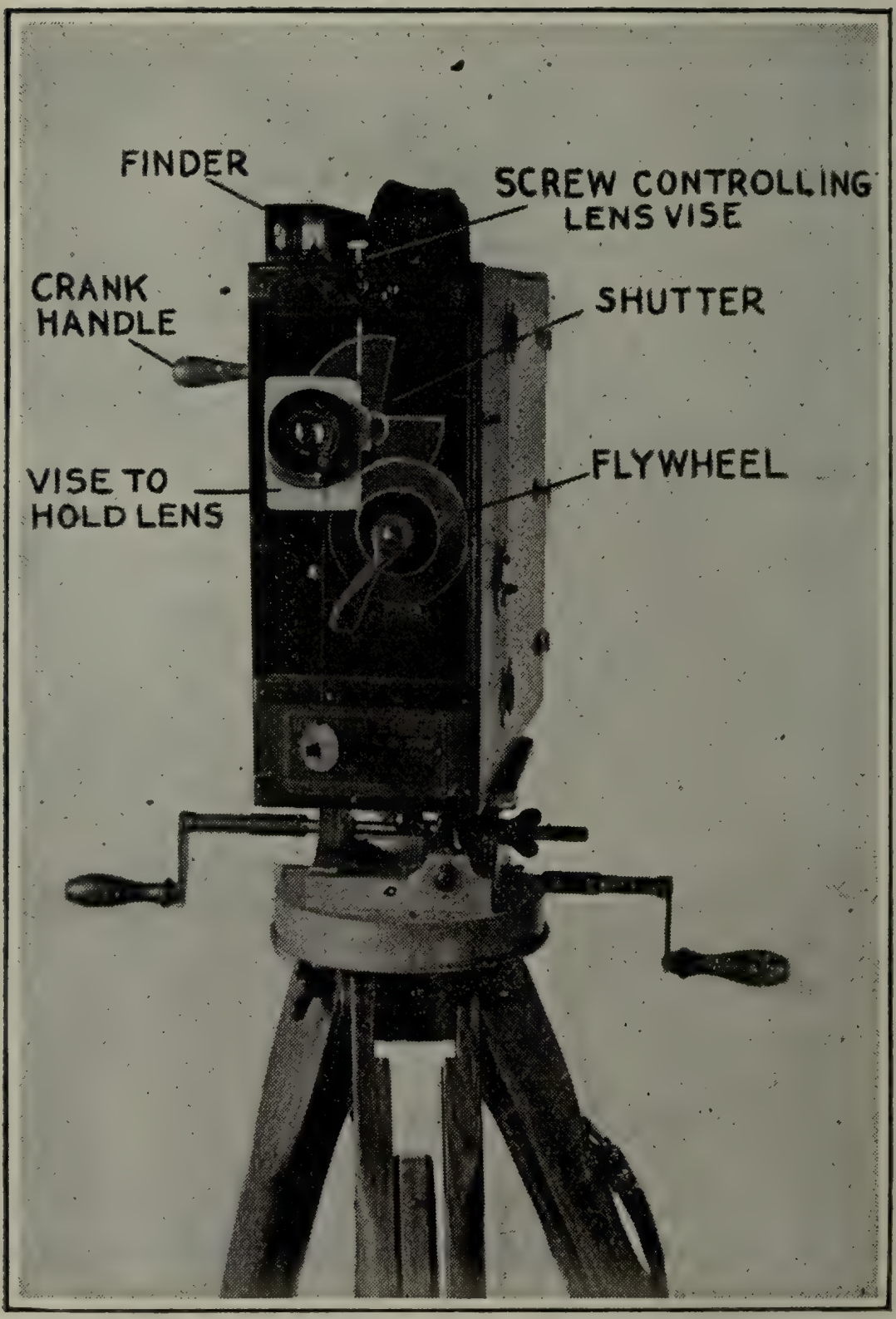
Front view of Universal camera, with the various features indicated. This model takes 200 feet of film at one loading.

unexcelled. Its compactness has made it a great favorite with explorers and travelers who do not wish to be burdened with the heavier outfits.

The Universal Camera

The Universal Camera is so constructed that every moving part is directly connected to one main casting, which insures permanent optical adjustment, perfect operating mechanism, and protection against disarrangement through rough handling or climatic change. The case is of reinforced aluminum and seasoned hardwood, especially treated, to ensure against warping, climatic changes, etc., with a durable waterproof enamel. The latches, which hold the two side doors and the front removable panel in place, are operated without the use of a key. Every working part and adjustment is easily accessible, but thoroughly protected. There are no bulky protruding parts to interfere with handling. A black leather carrying handle is attached to the top of the case with strong brass screws. There are also brass rings for attaching shoulder straps. The size of the camera over all is 4¾ by 11 by 12 inches, and complete the weight is only 20 pounds.

The mechanism of the Universal camera is simple yet ample for the requirements of good photography. There is one large master gear from which all moving parts are driven. This centralization of power simplifies the machine, gives the highest efficiency, and makes every piece accessible. The gears, both large and small, are cut with extreme accuracy. The effect is smooth, noiseless operation.



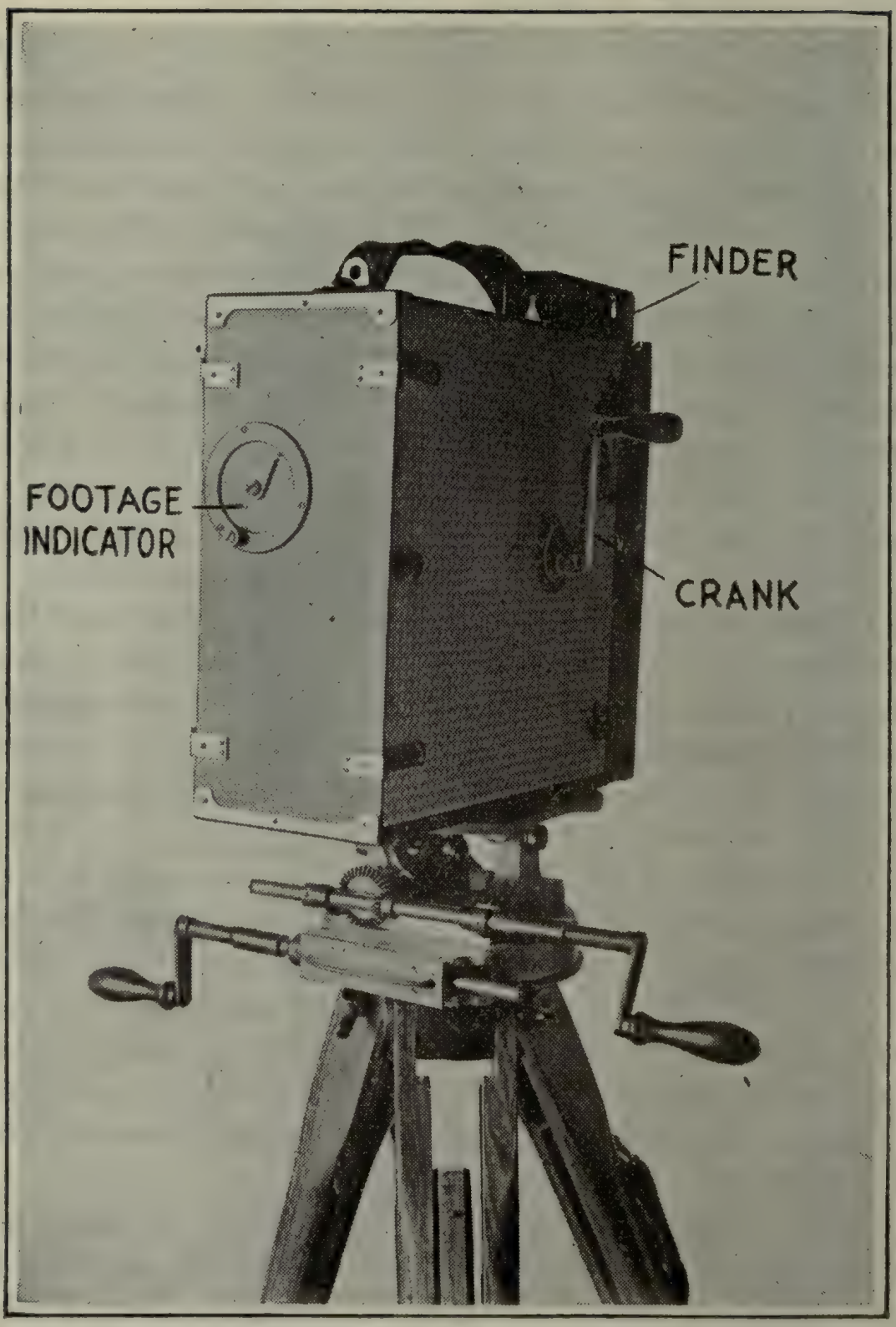
Universal camera with the front panel removed, so as to show the shutter and fly-wheel.

The balance wheel, which ensures a smooth operation for the camera when being cranked, is mounted on a strong pinion shaft with an outboard bearing to give it absolute rigidity. It is turned by the main gear, and by means of a positive action cam operates both the shuttle and pin yoke. The perfect registration of the film is secured by an intermittent shuttle movement propelled by a positive mechanical cam directly connected to the fly-wheel shaft. All of the parts are hardened and ground to ensure long wear. The top and bottom of the shuttle are fitted with adjustable gibs to insure precision of adjustment.

The pins which engage with the perforations of the film move in a straight line and enter the set of perforations slightly above the point of registration with positive straight in and out motion which cannot mutilate the film in any way. It is made to operate forward or backward.

The shutter is quickly adjustable, and may be set for from 25 per cent. to 50 per cent. opening. Under ordinary light conditions and ordinary speed, 37½ per cent. is found to be the correct opening, but for quick action and extra strong light, or vice versa, the shutter opening can be instantly set to suit the condition, thus giving the best possible results for all occasions.

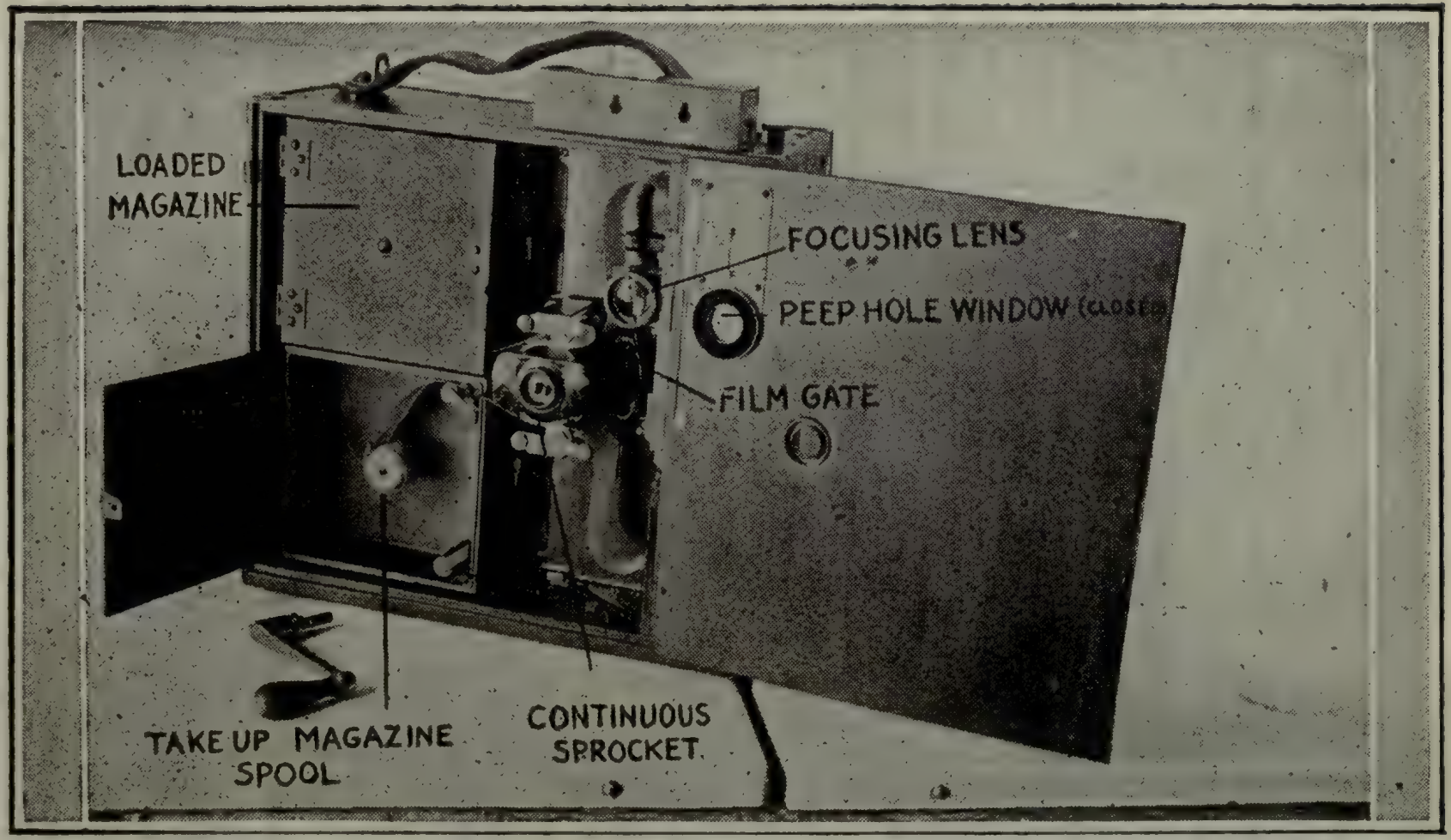
As for lenses, the standard equipment of the Universal Camera is a Bausch & Lomb Tessar F:3.5, mounted in a screw adapter of suitable length for proper focus, which may be quickly removed or adjusted by a screw that terminates in a knurled head at the top of the camera. By a simple twist of this



Rear view of Universal camera, showing the footage indicator at the back, the crank, and the finder.

knurled head, a pair of clamps are loosed and the lens can be removed for inspection or for replacement by another lens. The author, who has used a Universal Camera for over three years in various kinds of social, industrial, educational and special scientific studies, has the standard 2-inch focus B. & L. Tessar lens for the usual run of work, and a Dallmeyer (British) F:6 lens of 6-inch focus for long-shot work, where it is necessary to film subjects from some distance away yet secure a close-up effect. The 6-inch lens, as we have learned from the data on lenses given in the previous chapter, gives three times as large an image as the 2-inch lens for subjects photographed at the same distance away. The author has found such a lens invaluable for filming wild animal life; and many a time a subject, such as structural iron workers, important persons, news events and so on can only be secured by using a long-focus lens. The author's outfit further includes a 2-inch Faliez (French) lens of F:2.5 speed, which he employs for indoor pictures and on unusually dull days. Used wide open, this lens proves quite excellent in instances where the slower lenses would produce a very much under-exposed negative.

Sooner or later every practical cameraman, whether amateur or professional, is obliged to obtain a collection of lenses for various kinds of work. The author would suggest a 3-inch lens, a 1½-inch lens for wide-angle work, such as interiors where the camera cannot be moved back a sufficient distance from the subject to take in the entire subject when using the usual 2-inch focus lens, and a soft-focus



Universal camera opened, showing the film side. Note the various features, including magazines, film gate, focusing lens, continuous sprocket, and the peep hole window.

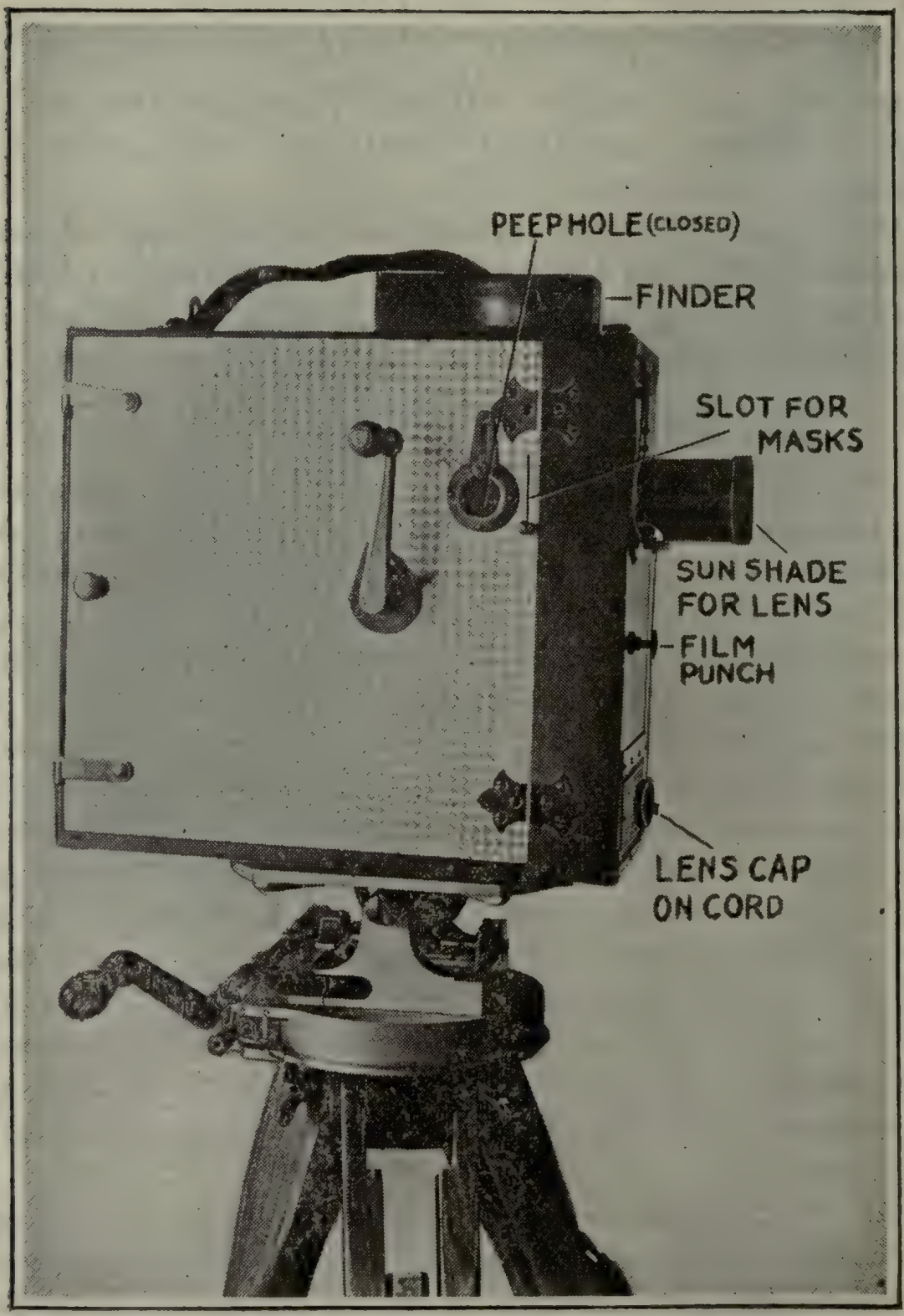
ens for highly artistic, diffused focus pictures which re so widely appreciated in still and motion picture photography alike.

The ease with which lenses can be put in place and removed with the Universal Camera makes it a quite simple matter to change from one lens to another in filming operations, with very little loss of time.

Refinements of the Universal Camera

The focus tube is located just back of the aperture and attached to the film gate, which when closed connects with a window in the main door, provided with a sliding gate. This focusing tube is fitted with magnifying lens which enlarges the image on the film several times its size, making it possible to get a sharp focus on a small subject, and the eye is so near the focusing point that no detail need be lost. The lens can be focused either on a piece of ground film, or while the film is in place, the latter being the quicker when the illumination is good. Of course, the lens mounting is calibrated in feet, so that the focus can be set by referring to the focus scale after estimating the distance between camera and subject. However, for accurate work it is always best to focus on the film or ground glass, as will be explained in the next chapter.

An adjustment for instantly raising and lowering the position of the image in relation to the perforations on the film is supplied on the Universal Camera. This feature, the variable frame line, as it is called, is quite important, since some film producers in Europe still perforate opposite the frame line instead



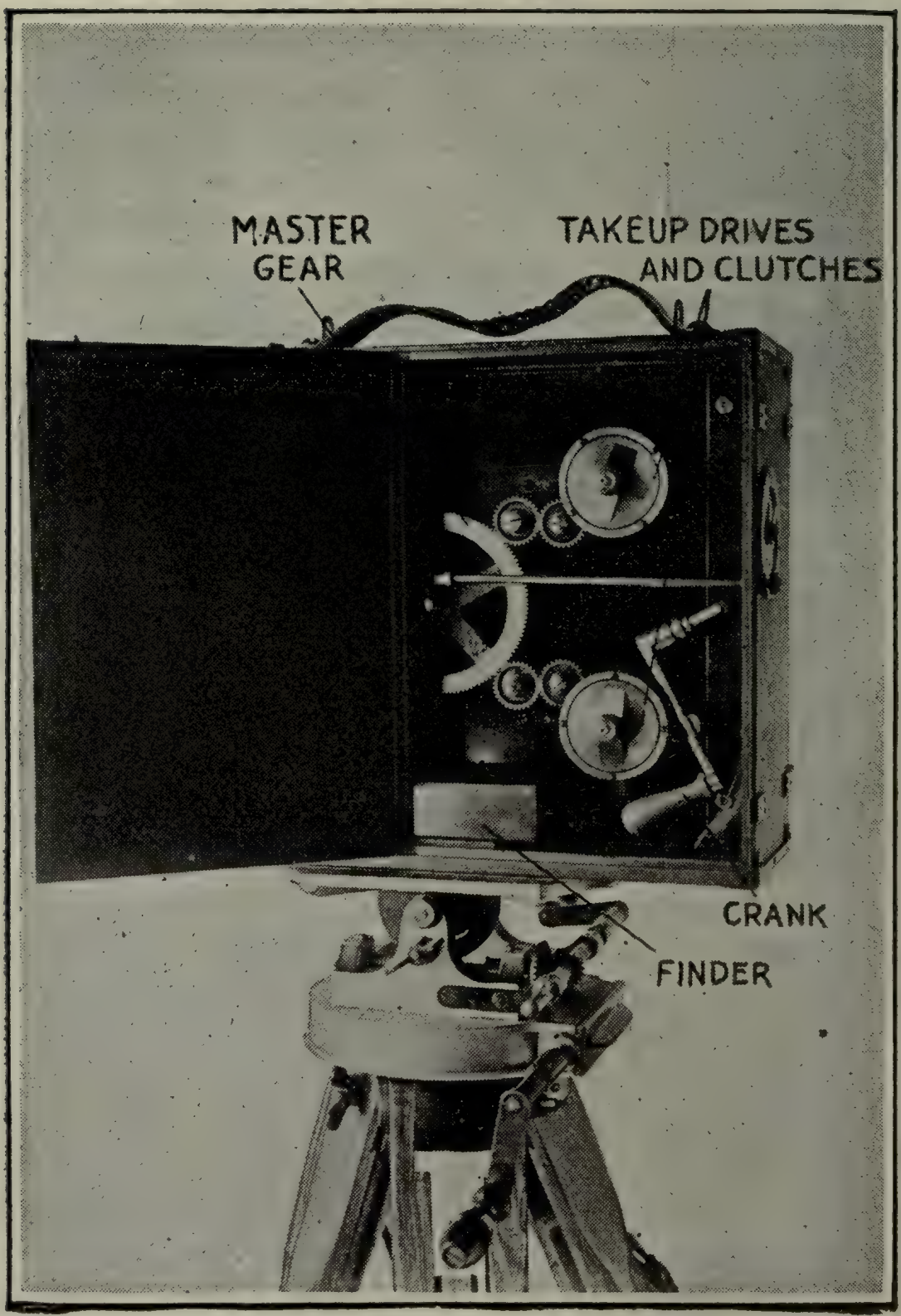
Side view of Universal camera, showing the eight-pictures-per-turn crank usually employed, as well as the various parts that figure in filming operations.

of alongside the frames, as has already been explained. To match up with those few film producers it is necessary to vary the frame line in the camera.

Mask plates of every conceivable description may be used and can be inserted from the outside of the camera without exposing any film. These masks are for the purpose of altering the outline of the frames—changing them from the usual rectangular form. Thus there are keyhole, overlapping circles or "binocular," round or "telescope," star, oval and other shaped masks, as well as companion masks which serve to block first one section of each frame during the first exposure, and then, when the film is wound back again and the second mask is used in place of the first, the already exposed portion of each frame is protected while the remaining unexposed section is exposed. These companion masks are used for all kinds of double-exposure and trick effects. In the case of the Universal Camera each mask, made of steel, is grooved to prevent wrong insertion. This feature, together with a quick interchange of lenses, will enable the skillful operator to produce remarkable effects. There are sixteen different masks to choose from.

A period punch is mounted on the film gate which may be operated by a push button outside of the front of the case. The perforation is close to the last picture taken, and serves to indicate to the darkroom hands where each scene begins and ends.

The movement of the Universal Camera may be reversed by merely turning the crank handle backward or toward the left, for specials, composites, dream and trick pictures. There is also a stop-picture



Gears and transmission system of the Universal camera exposed to view. Note how the crank and finder are placed inside the case while not in use.

or trick-picture shaft, for novelty effects. This device, making one exposure at a time, is on the left side of the case, and is operated by the regular handle so that it will never be used by mistake.

A view finder is attached to either the top or the side of the case so that the operator can see the image at all times, enabling him to follow and keep in view the object to be photographed. This feature, in connection with the usual tilting head and panoramic tripod, gives the operator the fullest control; the panoramic attachment gives full horizontal movement, and the tilting head permits of an angle either up or down of 45 deg. from level.

The film channel is made to open like a gate. It is made of steel, carefully hardened and ground true. The tension block and shoes are of highly polished steel. There is also a self-adjusting side tension rail which guides the film in a perfectly straight line. An important feature which should be carefully considered in the purchase of a moving picture machine is that of static troubles—tiny tree-like or lightning-like streaks which turn up in the developed negative, indicating that charges of static electricity have been generated while the negative was being passed through the camera mechanism. This static marking often ruins an otherwise perfect film; for once it is on the negative there is no possible way of eradicating it. It forms part of the image. The Universal Camera is practically free from this hindrance; owing to its metal construction, the camera is thoroughly grounded at all times through the body of the operator. In his long experience with the Universal

Camera the author has never had static markings on his film, even those taken during extremely cold weather. However, he has always been cautious in selecting the so-called Eastman X-back negative for filming operations during extremely cold and dry weather. X-back film is provided with an extra coating on the reverse side, which serves to ameliorate static troubles.

The footage indicator dial of the Universal is unique in that it tells not only how much film has been used but also indicates the amount used on the last scene. The figures are large and clear and easy to read. The dial is located on the outside of the back of the case in full view of the operator, who can ascertain at a glance how near is the end of the film.

The take-up mechanism is a positive mechanical gear drive which can be operated forward or backward. Friction disks with adjustable spring tension are used on the take-up shaft, which steadies the action and gives the desired tension.

The magazines are made of cast aluminum with hinged doors. They are provided with two outlets and are interchangeable. Only one empty magazine is required no matter how extended a trip. Each magazine has a capacity of 200 feet, hence four extra magazines, making a total of one thousand feet, will be more than is required for an average day's work out-of-doors. They are light in weight, easy to handle, and are attached by a simple spring clamp that automatically grips each magazine in place. The outlets are velvet lined and have detachable brass clips, which render them absolutely light-proof, and

also permit of their being taken apart for cleansing. This is an important consideration, since film, passing continuously over the little velvet pads, in time wears them down on the one hand, and, on the other, leaves

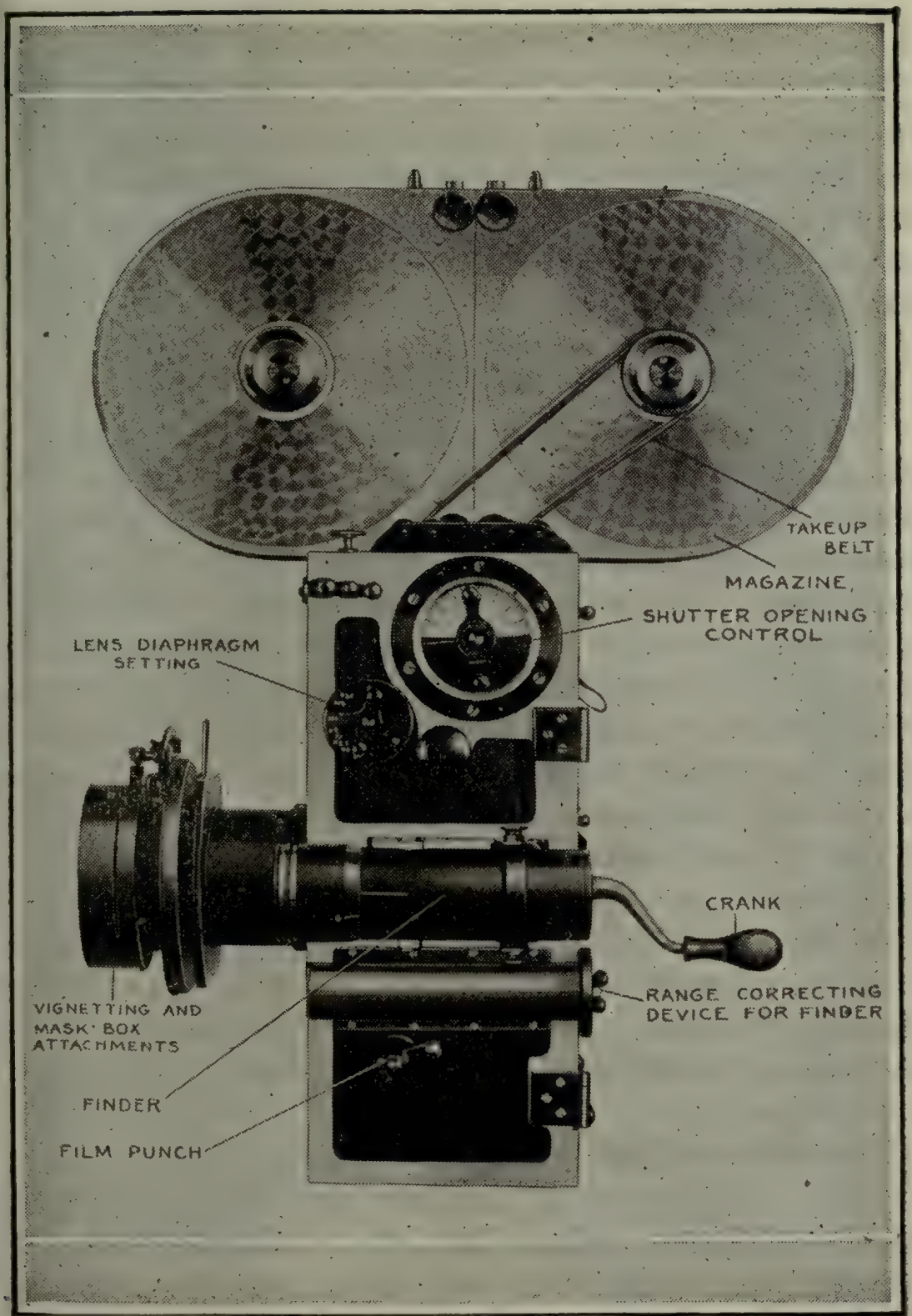
Universal camera equipped with a 6-inch lens. Lenses may be readily changed on the Universal camera by means of its lens vise feature.

small bits of film which are apt to scratch the fresh negative.

Still another important characteristic of the Universal Camera is the fact that the spindle of the

magazine is arranged to receive the original spool on which the film comes from the maker. No rewinding is required as in certain other cameras wherein a special metal spool is used in each magazine, and wherein, as a consequence, the film must be unwound from the usual wood spool and on to the metal spool, with the attendant danger of fogging, scratching, dirtying or otherwise spoiling the film. No rewinding is required with the Universal. Then again, loading and threading are so simple that the Universal Camera can be rapidly handled, which is an important consideration in fast work. The outlets in the magazines are so slotted that the film can be slipped into place from the side of the open magazine with one hand. In fact, the author has come to the practice of loading his Universal magazines by the sense of touch, using a heavy blanket or bed quilt as a protection against light. More elaborate magazines might not permit of such ready loading.

So much for the Universal Camera, which is recommended without hesitation to the amateur and professional alike for all straight photography undertakings. Perhaps the best recommendation is that of the United States Army Signal Corps, which made use of hundreds of Universal Cameras for recording the story of our part in the great war. In fact, in order to meet the particular requirements of the Army, the Universal Camera has been designed for four-hundred foot capacity, with the same mechanism but of larger proportions. Also, the later-day models are provided with an automatic dissolver in the form of a shutter that can be manually or automatically



Side view of the Wilart camera, with the various parts indicated. The vignetting and mask-box attachments are extras, of course, and are not to be considered as integral parts of the camera.

opened or closed while the camera is in action. Thus the shutter may be gradually opened, by hand or by a train of gears set for the desired footage to be covered by the fade-in effect, or gradually closed in the reverse manner.

The Wilart Professional Camera

For those who seek a more elaborate camera than the Universal, with various additional features that permit of fancy photography, there is the Wilart Professional Camera, which is the outcome of years of experience. Here again refinement in construction has been given the closest study in order to combine simplicity of operation with the most perfected types of mechanism and so accomplish with the greatest ease every photographic possibility in the production of motion pictures.

Let us begin with the case, which is a logical starting point. The Wilart case is constructed of a composition alloy metal that combines lightness with the greatest degree of strength. In fact, the Wilart Camera consists of metal parts throughout, which assures an instrument that is unaffected by climatic conditions.

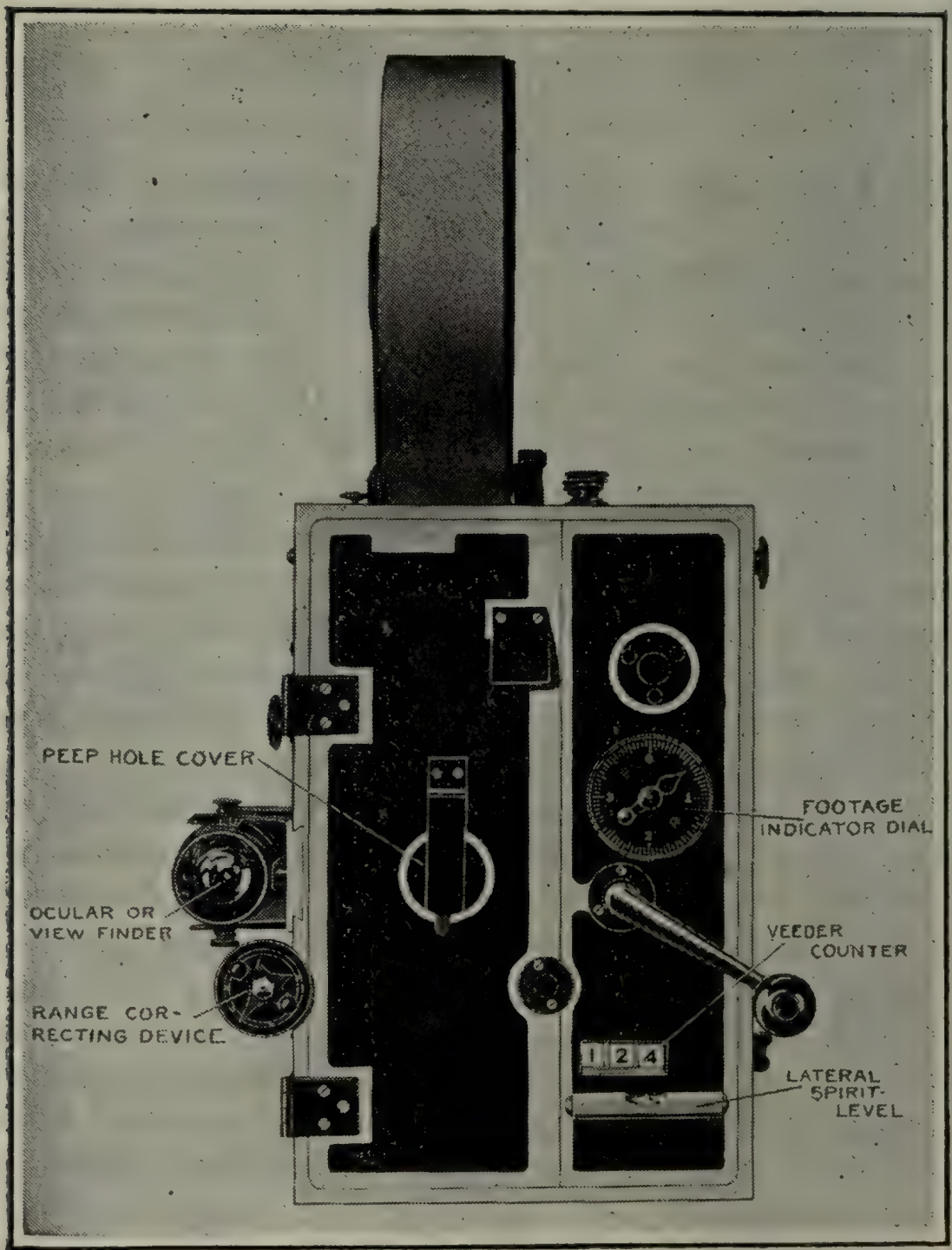
The lens equipment may be either a B. & L. Tessar, a Goerz Hypar, or a complete set of special lenses imported from France by M. H. Schoenbaum, as regular equipment, but any other lens may be substituted if desired. The lens holder is made with threads on two quadrants so that the lens may be removed by a quarter turn, thus expediting the changes of lenses. Extra lenses may be mounted on

the inside of the door and secured in holders threaded in the same manner as the principal holder. The change from one lens to another, therefore, can be accomplished without the slightest inconvenience and in the shortest space of time. The lens focusing mount is attached to the side of the camera case at the operator's left hand and is provided with a micrometer adjustment.

Now the focusing indicator is provided with markings which may be depended upon to produce the most accurate results. The location of the focusing dial at the back of the camera is the most convenient arrangement for the operator, as will be noted when we come to the chapter on camera work.

The view finder is at the left of the operating position. It is mounted on the side of the camera in a dove-tail slide bearing making it easily removable. A pin latch holds it securely in its regular position. The view finder lenses are matched with the photographic lenses, and are provided with adjustable diaphragms so that the image may always be seen in proper focus, whereas with the ordinary view finder the object may always appear well defined. There is also a magnifier for enlarging the image.

The focusing barrel of the finder is fitted to the cylindrical casing of the finder by means of a micrometer adjustment. The barrel has calibrations for various distances, with a registration line on the cylinder casing. The cylinder casing is carried on swivel bearings to effect a side-to-side adjustment for the range-finder, which also carries calibrations. When the proper focus is obtained with the view



Rear view of the Wilart camera, showing the crank, finder, footage indicator, peep-hole and other features.

finder, the range-finder is set to the same distance registration so that the photographic lens and the view finder lens coincide on the point of focus. This is a highly commendable feature, especially when it is

remembered that the usual finder is aimed parallel to the photographic lens, so that their lines do not coincide. Thus in working on close-ups the margin of error between view finder image and recorded image is apt to be sufficient to mean a serious error. With the Wilart Camera the view finder is so adjusted that it represents exactly what the photographic lens is recording.

The Wilart Camera is equipped with two shutters. The principal shutter is mounted on the main shaft, while the auxiliary shutter is mounted on an external sleeve which is fastened to an internal sleeve fitted with spiral slots by means of which the aperture opening may be regulated by a pin operating in the spiral slots. The shutter opening is controlled by a revolving disk of the shutter dial which registers the degree of shutter opening on the graduated dial on the upper side of the camera case. Shutter adjustments are made without opening the camera. It is possible to reduce from the full shutter opening to a complete closing by this manual control in as short or as long a period as may be desired, or the dissolve may be effected automatically by the pressure of a button.

The Wilart Professional Camera—for let us not forget that this is a true professional camera—has a shutter equipment so arranged that the reduction from full aperture opening to complete closing is accomplished automatically in 4½ feet, or 9 turns of the handle. By pressing a button the gear is thrown into mesh with the dissolve gearing mechanism and operates the opening and closing of the shutter and

automatically and at the same time the shutter indicator on the graduated dial shows when the dissolve is completed. Pressure on the button should be released when the indicating dial shows closed, and a few turns given to the crank to insure that sufficient film to produce the entire dissolve has been wound into the magazine. The button should then be pressed again until the registering dial shows a full opening. The shutter indicator being in black and the dial in aluminum facilitates the reading of the exact degree of the shutter opening.

The automatic dissolve mechanism of this camera is of the utmost importance in the making of "trick" or "visionary" pictures and insures success over the ordinary camera where the dissolve must be accomplished by slowly closing the diaphragm on the lens, which not only is inconvenient but makes it quite difficult to obtain good results.

The film movement in the Wilart Camera is controlled by the film feed sprocket, the shuttle, the aperture plate, the gate, pressure pad, pressure shoes, and parallelogram. The film is fed from the magazine through a slot in the top of the camera and is engaged by the feed sprocket. A slight loop in the film is made between the feed sprocket teeth and the claw teeth of the shuttle.

The film is held against the photographic aperture plate by means of the gate, which has a removable pressure pad and also pressure shoes which hold the film against the aperture plate to ensure the proper engagement of the claws of the shuttle with the perforations of the film. A parallelogram is used for

the guidance of the film on the aperture plate to avoid the possibility of any side motion. The tension of the pressure pad can be adjusted by a tapered thumb nut.

The movement of the claws of the shuttle to pull the film downward in a vertical plane is actuated by a special Wilart cam and "drunken" screw mechanism, which assures the correct position of the film before the photographic aperture.

The removable pressure pad in the gate is provided with an opening in line with the camera lens which permits of direct focusing on the film by opening a gate at the back of the camera case, when desired. A tube mounted on the inside of the rear door closes against a flange of the pressure pad so that no more than one picture would be fogged when focusing through the back. Focusing in this manner is done without opening the camera, same as the Universal Camera. It is possible also to use a solid pressure pad if desired so that by removing the film from the aperture, ground glass may be inserted in place of pressure pad for focusing.

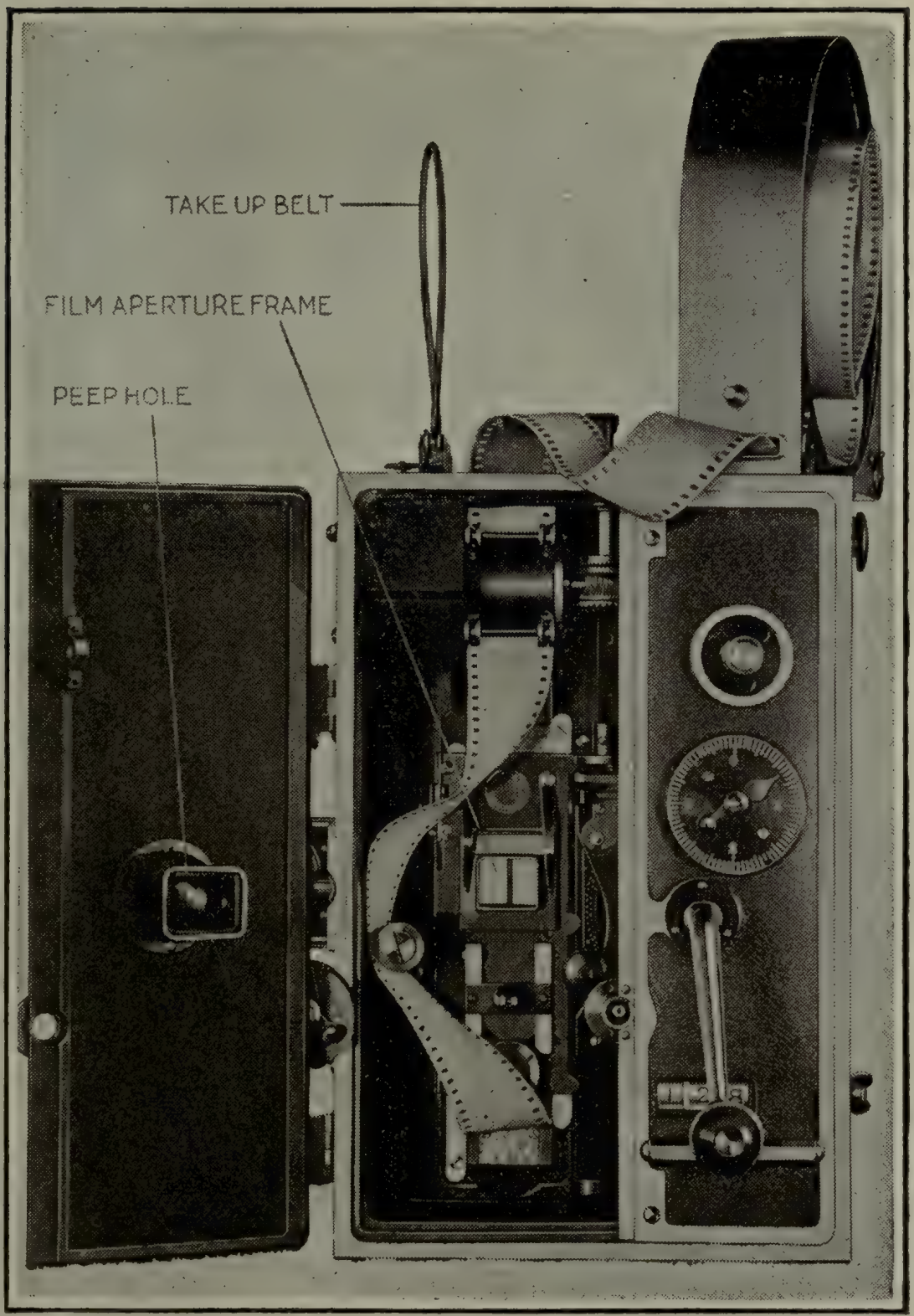
A special feature of the focusing dial which is very useful is the ability of the operator to obtain a follow-up focus on an approaching or disappearing object. By gauging the focal distance of the moving object it may always be kept in proper focus by turning the focusing indicator forward or back as occasion requires. For instance, if the object is six feet from the camera and starts to move away, the dial would be turned accordingly. It might stop again at fifteen or twenty feet, but the dial would have been turned

for that distance so that perfect focus would always be possible. In outdoor work, when the lens is cut down, follow-up focus is unnecessary.

For special stop motion effects, speeding up scenes, trick pictures, etc., a special crank shaft is supplied so that the regular crank may be attached to a gear ratio which will give ⅛th of the shutter speed with the normal crank revolutions of two turns per second. This insures the same accuracy in making these exposures as is obtained in the regular operation of the camera.

In trick picture work the Veeder Counter is of great assistance. This registers each turn of the crank so that it is necessary only to note the number of revolutions from the time the exposure is started to the finish. Then reverse the belt that drives the take-up magazine by crossing it on the magazine pulleys and note again the same number of revolutions on the counter and the film will be set back at exactly the same point that the picture was started. The Veeder Counter is built into the Wilart Camera with its dials showing through a window at the rear of the case, right above a lateral level indicator.

Another distinctive feature of this camera is the design of the magazines, which are adapted to receive 400 feet of film. These magazines are made of cast aluminum. The cover is threaded so that it is easy to remove and replace. The magazine unit is made in halves. The receiving and delivery containers are interchangeable and reversible so that when a film has been exposed a compartment containing the fresh film may be put in its place and the re-



Rear of Wilart camera with door opened to expose the film track and gate. The right-hand part of the cover also opens to give access to the gears and other mechanism.

cently emptied compartment transferred to the receiving side.

A flanged opening allows the passage of the film from the magazine compartment into the camera through a slot in the top of the camera case. This joint is accurately fitted for the exclusion of the light. Grooved pins, cast on the magazine, fit into accurately machined holes in the top of the camera case. Sliding tongues of keyhole design engage the grooves of the pins and hold the magazine securely in place by the setting of two thumb screws. Within the magazine compartment, directly back of the flanged opening, is the light gate. This is normally closed and is opened only when the magazine is in place and the camera door is closed and locked by means of the milled disk on the back of the camera which drives a bolt into a socket. Therefore, when the door is unlocked the magazine light gates are automatically closed again. The light gate, when open, allows an absolutely free passage of the film without any chance of friction on rubbing surfaces. When set for operation the two magazine sections are securely fastened together by means of a grooved latch.

Of course the Wilart Camera has a film marking punch, consisting in this case of a small lever on the side of the camera. There is also a graduated footage dial above the crank handle.

Static trouble is claimed to be a practically unknown quantity in negatives made with the Wilart Camera. Static is produced by difference in temperature and it is a well-known fact that static electricity

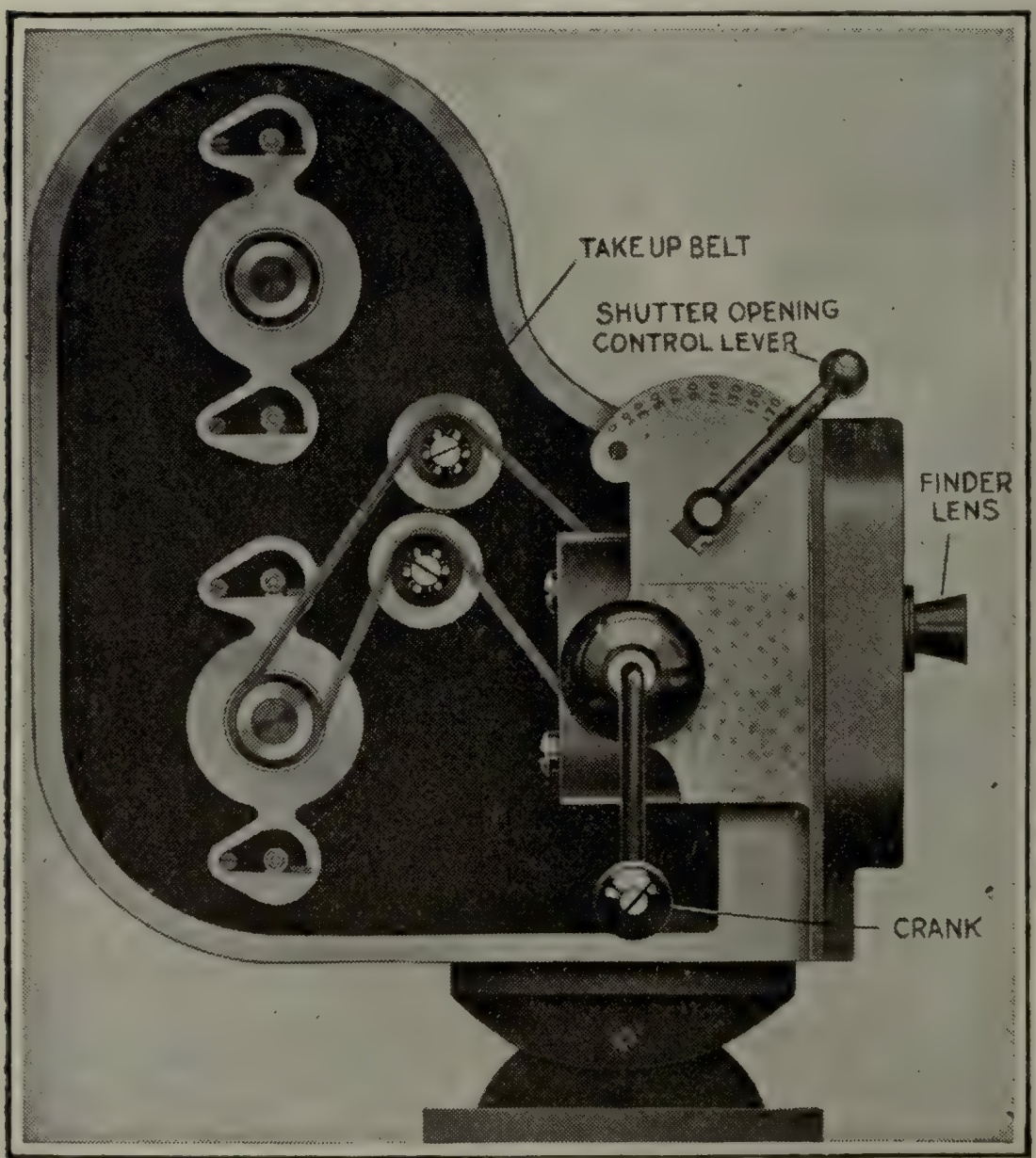
is produced by film being in contact with non-conducting material such as wood, cloth, etc. The Wilart Camera being of metal construction throughout, with no lining of any kind in the magazines, preserves a uniform temperature which is most essential for the prevention of static.

In this camera provision has been made for the use of masks in order to accomplish, in the most convenient manner, the making of the very widest range of dissolve scenes, "trick" and "visionary" effects. By sliding the view finder backwards, two slots are uncovered for the insertion of masks which can be obtained in a large variety. The insertion of a ray filter in the slotted openings in front of the photographic aperture makes it possible to obtain beautiful cloud effects. A special advantage in being able to use the front mask opening for a ray filter lies in the fact that the filter may apply only to the upper or sky portion of the picture and allow the natural lighting for the lower portion. This is possible since the filter mask is a sufficient distance away from the lens to allow for proper diffusion.

The Later-Day Wilart Camera

As daring as the design of the Wilart Camera already described may be, it is tame, so to speak, when compared with its younger brother known as Model B, which has just been developed. The Model B Wilart Professional Camera represents a radical departure from all the standard types of motion picture cameras, as may be noted by studying the accompanying illustration.

Like the Model A Wilart, the Model B is of all metal construction. The similarity also extends to



Latest type of Wilart camera, known as Model B, in which the magazines are contained within the case.

the ball-bearing features, which make for extra long wear and light running. Spiral gears are used throughout. The weight of the Model B, loaded

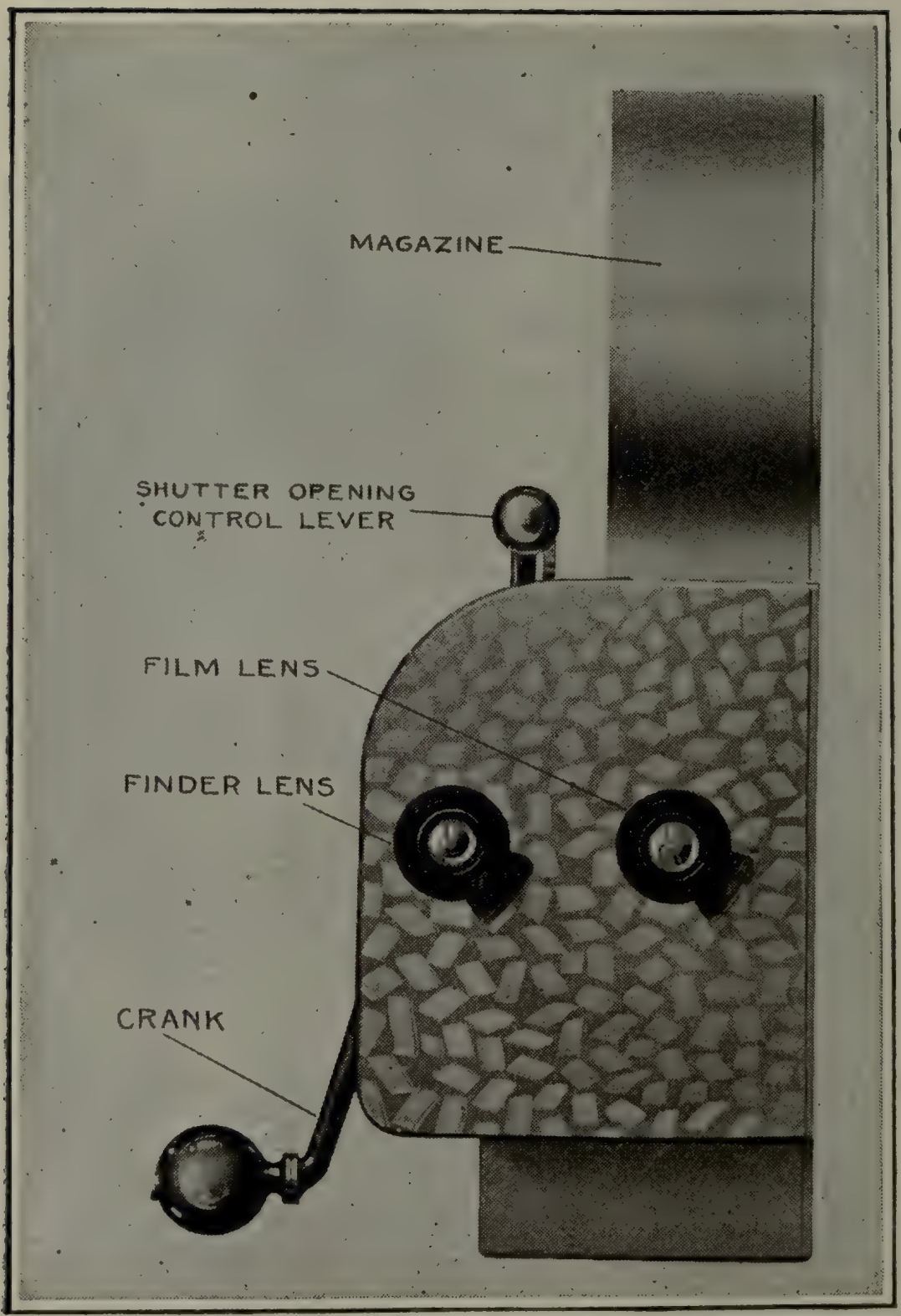
with 400 feet of film, is 19 pounds, the camera alone weighing approximately 14 pounds. Indeed, the weight of this all-metal camera, with its substantial construction, is the same as the lightest wooden camera.

The bizarre shape of the new Wilart Camera is accounted for by the fact that all waste space has been eliminated. The designer has aimed at extreme compactness. The magazines are placed inside the case instead of outside as in the older Wilart. Each magazine has an automatic light trap which is normally closed while the magazine is being handled, but opens with the closing of the door lock on the camera case.

The take-up is in the form of a spring belt, which is indicated in one of our views. This take-up, being on the outside of the camera, is always visible to the cameraman who can therefore tell if the take-up is functioning. The change from the forward movement to the reverse movement is effected by shifting the spring belt from the lower pulley to the upper one.

The designer claims that, owing to the narrow width of the Model B case, this camera can be carried about with the utmost convenience.

To sum up, the Model B is equipped with automatic and hand dissolve, the lever for changing the shutter opening being placed above and a trifle ahead of the crank, as depicted. The camera can be furnished without automatic dissolve if desired. The mounting of the lenses is such that they may be changed quite readily. In the matter of lenses the



Front view of the Wilart Model B. The simplicity of this camera is quite striking, and is quite distinctive in view of the elaborate types now in use.

same principle as with the Model A is carried out, namely, having matched lenses for the photographing lens and for the view and range finder, placed side by side. There is a footage dial, Veeder counter and a film punch.

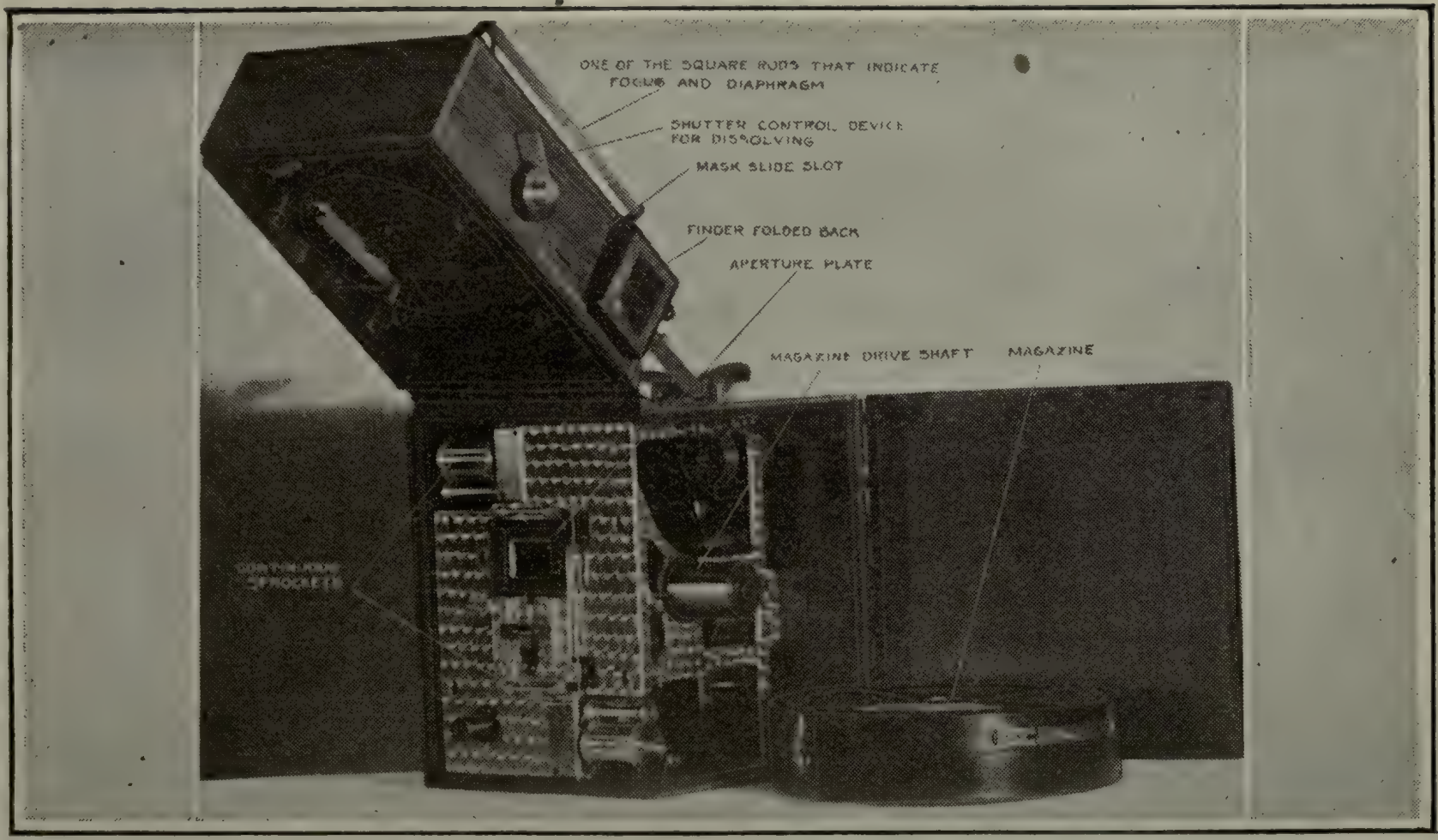
Features of the Debrie Camera

The compactness and light weight of the Debrie Camera, which is manufactured in Paris, together with its 400-foot magazines and numerous features that permit of doing the most elaborate filming, have made it a favorite with American cameramen for studio and outdoor work alike. In fact, it is employed to a considerable extent for news work, since it is one of the most compact cameras extant. It is well up among the higher priced cameras and must only be considered for the highest grade amateur work and for professional purposes.

A small walnut case bound with black metal trimmings characterizes the Debrie camera. Its magazines are arranged side by side, and while this means a somewhat more complicated path for the film to travel, it makes for extreme compactness, as is obvious from the accompanying illustration. Indeed, one is surprised to notice how many features have been worked into the mechanism of the Debrie, which is one of the lightest and most compact outfits made for serious work.

The new model Debrie Camera embodies the following features:

It is fitted with a film measuring device for footage. The Debrie has a cranking speed indicator



Debrie camera opened up, showing the film aperture plate and one of the magazines. Note how the front of this camera, which contains the lens and the shutter, is swung up to get at the film track. The compactness of this type recommends it for many kinds of work.

showing the number of pictures taken per second.

The mechanism incorporates an automatic take-up both forward and reverse so that it may be cranked in either direction without adjustments or changes of any kind. Further, the Debrie is provided with a new type of intermittent movement which is said to make for a smooth and precise action.

Focusing is accomplished from the rear, an optical system being provided for showing the image right side up in a magnified form. Focusing can be accomplished while the camera is being operated, without spoiling the film, by means of a special red glass window which excludes all active light when the eye is pressed against the focusing tube. Hence it becomes possible accurately to focus and to follow any given bit of action, which is an invaluable and absolutely necessary feature in some forms of filming. Focusing can be accomplished on a ground glass at the aperture at any time without opening the camera or removing the film. A hole is punched in the film and a ground glass introduced into the opening thus formed from the outside of the camera, thereby calling for a minimum effort and practically no waste of film.

The automatic dissolving shutter of the Debrie Camera is built into the mechanism. It is arranged to close in three and one-half feet, when the camera crank locks. In reversing to the original point with the shutter closed, the camera crank again locks. The dissolve is accomplished in the same number of feet every time it is employed, without regard for the

shutter opening being used. This feature is believed to be unique with the Debrie.

The special lens mounting of the Debrie Camera permits of changing the lenses without trouble or loss of time. The diaphragm can be changed from the rear while the camera is being operated, thus allowing for fluctuating light conditions. In order to facilitate the changing of lenses, it will be noted that the Debrie camera is provided with a square rod on the right-hand side, looking at the front, and another at the top. These rods are marked on one or more sides with the diaphragm stops and the distances in feet for one or more lenses. Thus when the operator changes from one lens to another, he has only to turn the square rods around until the proper scales face the rear. He then adjusts his lens for distance and for diaphragm opening by moving the long rods that work in front of the scales facing him.

The magazines are of four-hundred foot capacity, and of metal construction. They fit side by side in the camera case. For threading, the two sides of the camera are opened, while the front portion is thrown up on its hinge as shown in one of our illustrations. The film is then threaded through the mechanism which is thus exposed to view. Once threaded, the front is dropped down in position and locked, and the two side doors are closed.

The Debrie Camera weighs 14½ pounds and measures 10½ inches long, 7½ inches high, and 6 inches wide. The case is of five-ply walnut and is particularly designed for use in all climates. All in all, the Debrie is an ideal camera—and its wide use

by American cameramen attests to its efficiency. It is excellent for news and travel work.

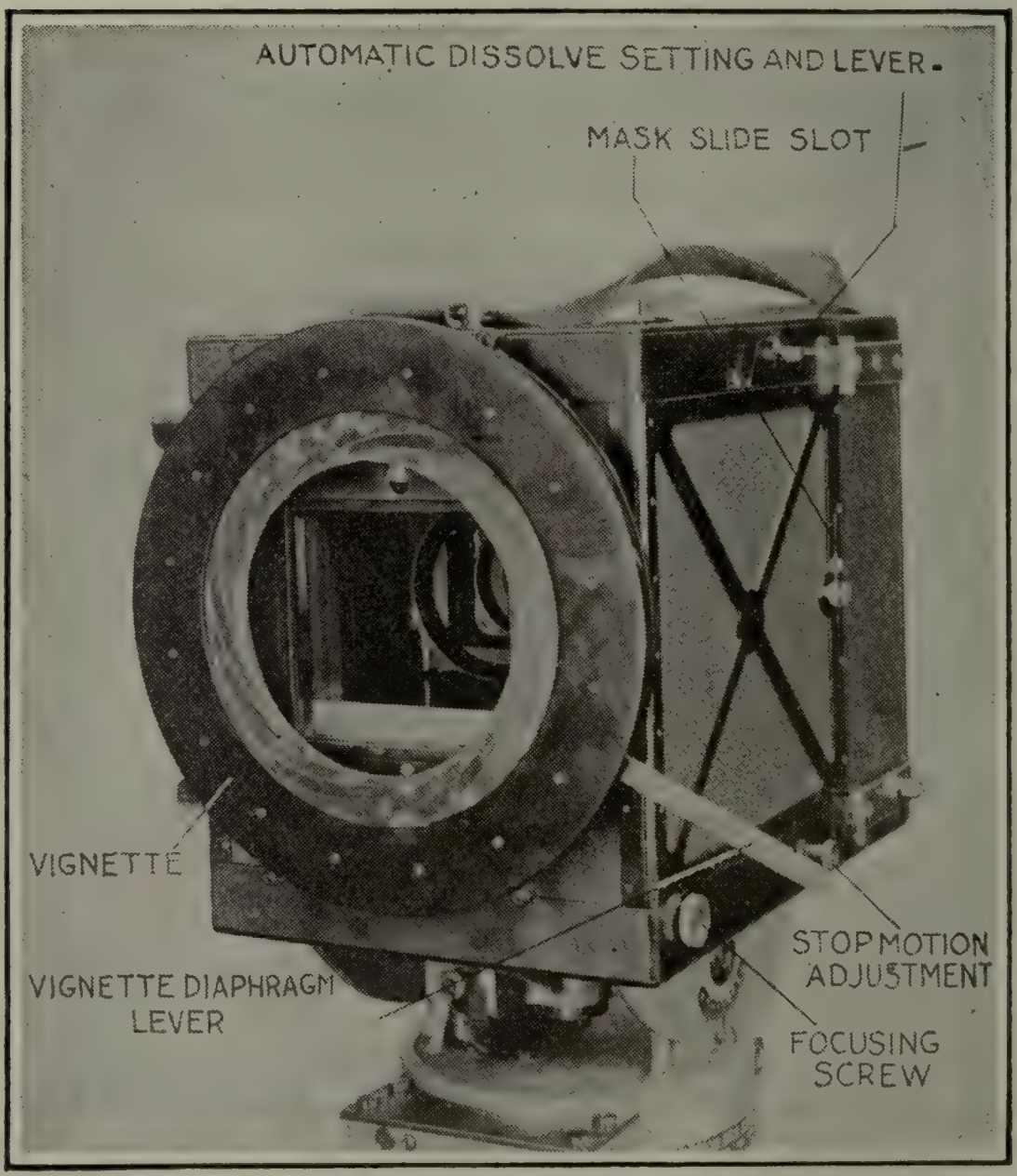
Features of the Russell Camera

Somewhat similar to the Debrie Camera, but not so well known and only employed to a limited extent at present because it is a relatively new type, is the Russell Camera. This camera includes so many interesting departures from current camera practice that it has made a place for itself in what was already a much crowded field.

No doubt the most striking feature of the Russell Camera is the ground glass device, which makes it possible to swing aside the film and the gate and to swing into their place a ground glass, by the mere manipulation of a tiny lever on top of the case. This operation is accomplished in an instant, and without wasting film. By turning the small lever ever so slightly, the entire gate, with its rollers and tension shoes holding the film in the proper position, is swung away from its natural position taking the film with it. No sooner is this done when, by the same action of the lever, an auxiliary aperture containing a ground glass is swung into position, in line with the lens and with the focusing tube at the rear of the camera. The focusing completed, the lever is turned in the opposite direction, swinging the ground glass carrier out of the way and throwing the film gate and film into normal position, ready to go ahead with the scene.

Like all the better types of cameras, the Russell is provided with a built-in dissolving shutter with the

widest latitude and sureness of operation. A lever is adjusted for any one of three speeds of dissolve.



Front view of the Russell camera. The vignette forms an integral part of this camera, and the lens, being set some distance back, has an effective sunshade.

On the opposite side of the case is the angular setting of the shutter opening. The controlling lever which

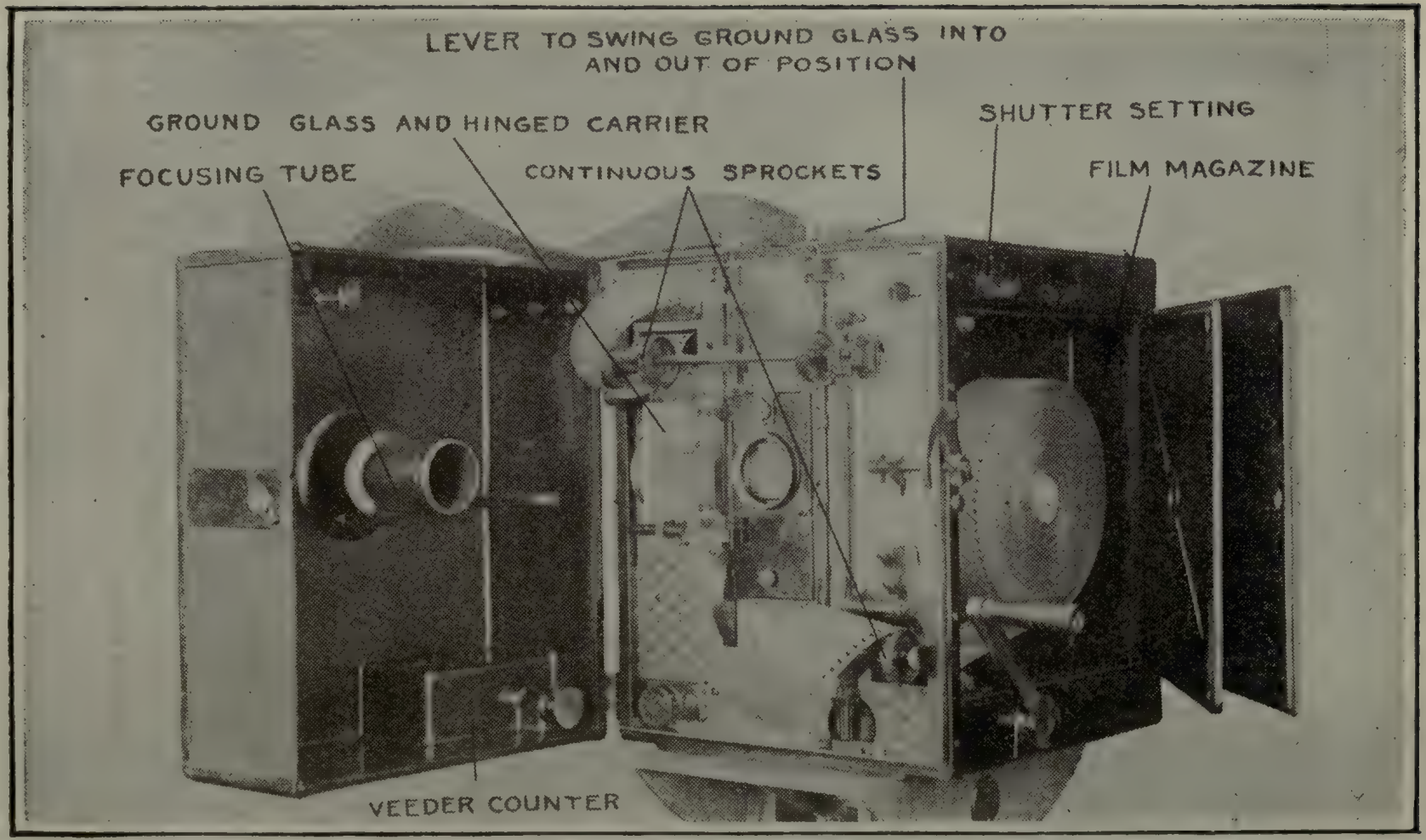
starts the dissolve in operation is conveniently located, and after the proper adjustments have been made this lever is pushed slightly forward or backward according to whether it is desired to fade-in or fade-out. Upon the completion of the operation the mechanism locks. The shutter, which can be set for any angle from 170 to 0 deg., can be operated by hand if desired.

The arrangement of the magazines in the Russell Camera forms another novel feature. One of these is placed on either side of the camera casing, after the manner of the Debrie design. The general construction of the case calls for the location of the lens some distance from the front plane of the case, so that the arrangement forms a natural sunshade, as shown in one of our illustrations. The vignetting and double-exposure devices are placed on the extreme front of the camera and when in place do not interfere with the rapid changing of lenses.

The lenses for the Russell Camera are mounted in special mounts supplied with the camera. The change from one lens to another is accomplished in a few seconds. The lens mounting and space available are such that up to a six-inch lens can be accommodated.

Focusing is accomplished either by a scale mounted at the rear of the camera, or by looking through a focusing tube at the rear which shows the image on the film or ground glass, in magnified form and right side up.

The mechanism is arranged for automatic take-up in either direction. The intermittent mechanism of the Russell Camera makes use of the claw movement,



Another view of the Russell camera, fully opened up to show its mechanism. The most novel feature of this camera is the focusing device, which permits of throwing a ground glass into position by the mere flip of a lever on top of the case.

Rear view of Russell camera, with the footage indicator and peep-hole plainly indicated. The crank is placed low down in this camera, so as to reduce vibration to a minimum.

but the manner in which this well-known movement has been altered and improved is noteworthy. The movement is ruggedly constructed, perfectly balanced and mounted in ball bearings.

Like all cameras in general use, the mechanism provides for the ordinary eight-to-one crank movement and the one-to-one. The crank itself is situated

at the lowest center of gravity, which reduces vibration. It is permanently attached to the camera and when not in use folds close up against the camera case and locks itself. Hence there is no danger of going out on a job without the crank, and, to use the popular expression, being "out of luck."

Instead of using wood or metal for their case, the Russell Camera designers have gone to a special moulded material known as Condensite. The various parts of the case are moulded into smooth panels, which are at once durable, non-warping and unaffected by weather conditions. Complete, the Russell Camera weighs slightly less than 20 pounds, with a 400-foot roll of film in place ready for work. The size of the camera is 9 inches high, 7¾ inches wide, and 10¾ inches long.

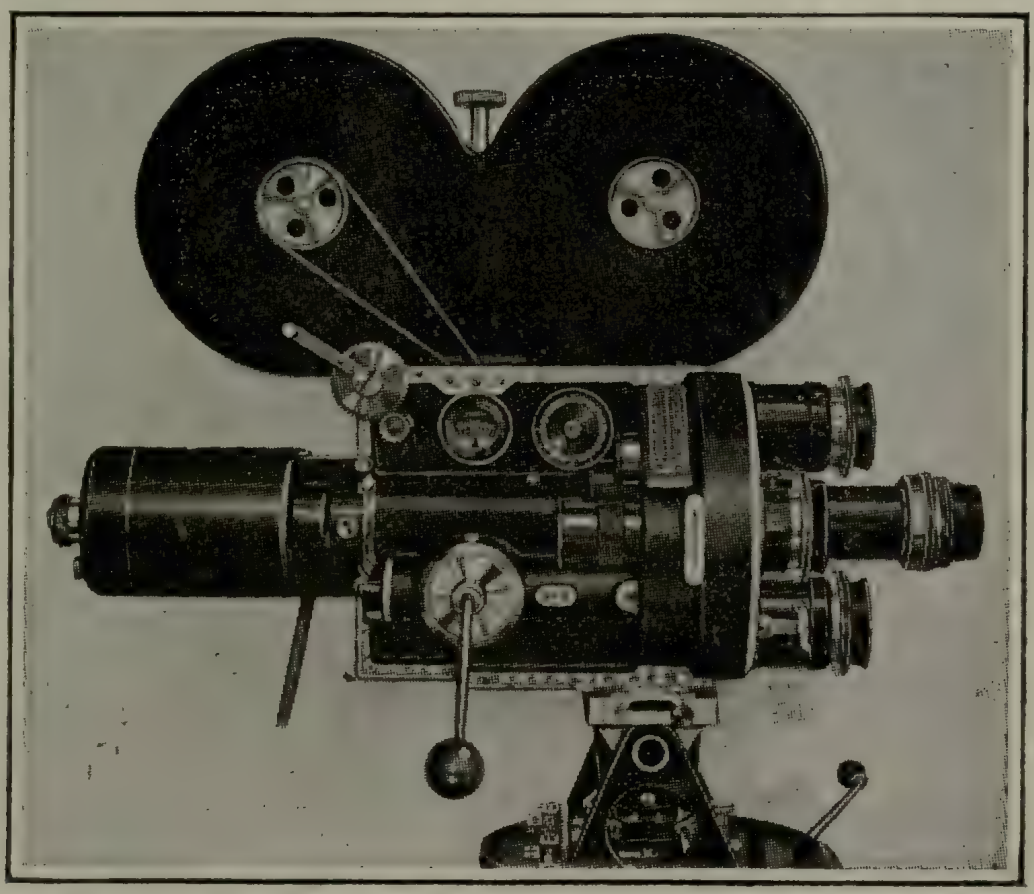
The Bell & Howell Camera

The most elaborate camera and no doubt the most widely employed in regular film productions is the Bell & Howell Camera, but so great is its cost that it would seem to be quite beyond the reach of anyone except the professional cameraman. At any rate, the Bell & Howell represents the last word in motion picture cameras, being provided with almost no end of attachments that expedite filming and make possible the numerous unusual effects that characterize America's leading film productions.

First of all, the Bell & Howell Camera is a sturdy piece of mechanism. The camera frame consists integrally of but four parts—the main frame, door, turret plate mounting and turret plate. It forms

the complete housing of the entire camera mechanism. The main frame is cast in one piece from special aluminum alloy.

Access is had to the interior of the camera by open-



The Bell & Howell camera as it appears when equipped with a special electric motor drive. This is the most elaborate camera extant, and incorporates practically all the refinements known to the art.

ing the door, which falls down to the horizontal position. The door is provided with a combination spring-actuated latch and contact plate. When the door is closed this plate engages with and operates the valve-opening mechanism of the magazine, which is mounted on top of the camera.

The main characteristic of the Bell & Howell is the lens turret plate, which is a revolving plate built to receive a plurality of lenses. It is composed of a 6-inch flanged plate with four circular openings machined to receive a corresponding number of lens mounts. This plate is mounted on a central bearing and is held in any one of the four positions corresponding to the desired lens to be used before focusing and photographing apertures. These apertures are identical as to dimensions and positions relative to the horizontal and focal planes. In traveling through its circular path the turret plate passes the position occupied by the high-power focusing microscope at the right-hand side of the camera, and can be stopped at this point when using this device.

The lenses generally employed with the Bell & Howell are the B & L. Tessars and the Carl Zeiss Tessars, or again the Goerz Hypar lenses. The lens equipment of the camera commonly consists of the following:

One each of 50 mm., 75 mm. and 32 mm. lenses in micrometer focusing mounts with matched view finder lens for each, or

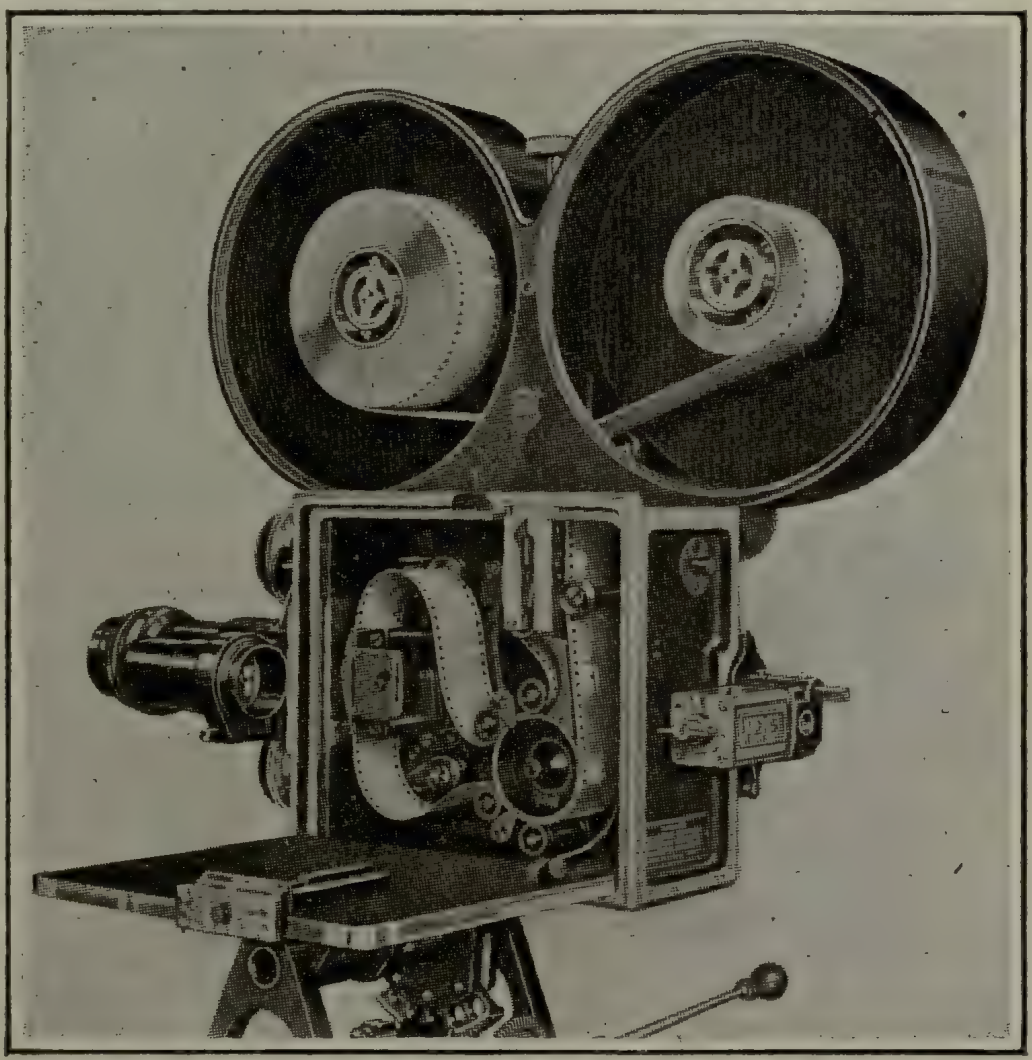
One each of 2-inch, 3-inch and 1⅝-inch lenses in micrometer focusing mounts, with matched view finder lenses for each and with choice of either combination.

One 6-inch long focus lens (the 3-inch finder lens is used as view finder for the 6-inch long focus lens by using only parts of its field).

Two distinct methods are provided for the focusing of the lenses of the Bell & Howell:

First, through a ground glass which is mounted in

a special focusing aperture on the operating or right-hand side of the camera and in the exact focal plane as the photographing aperture. This ground glass has



Bell & Howell camera opened, showing the path taken by the film. The magazines are combined in one unit, held in place by a long thumb-screw.

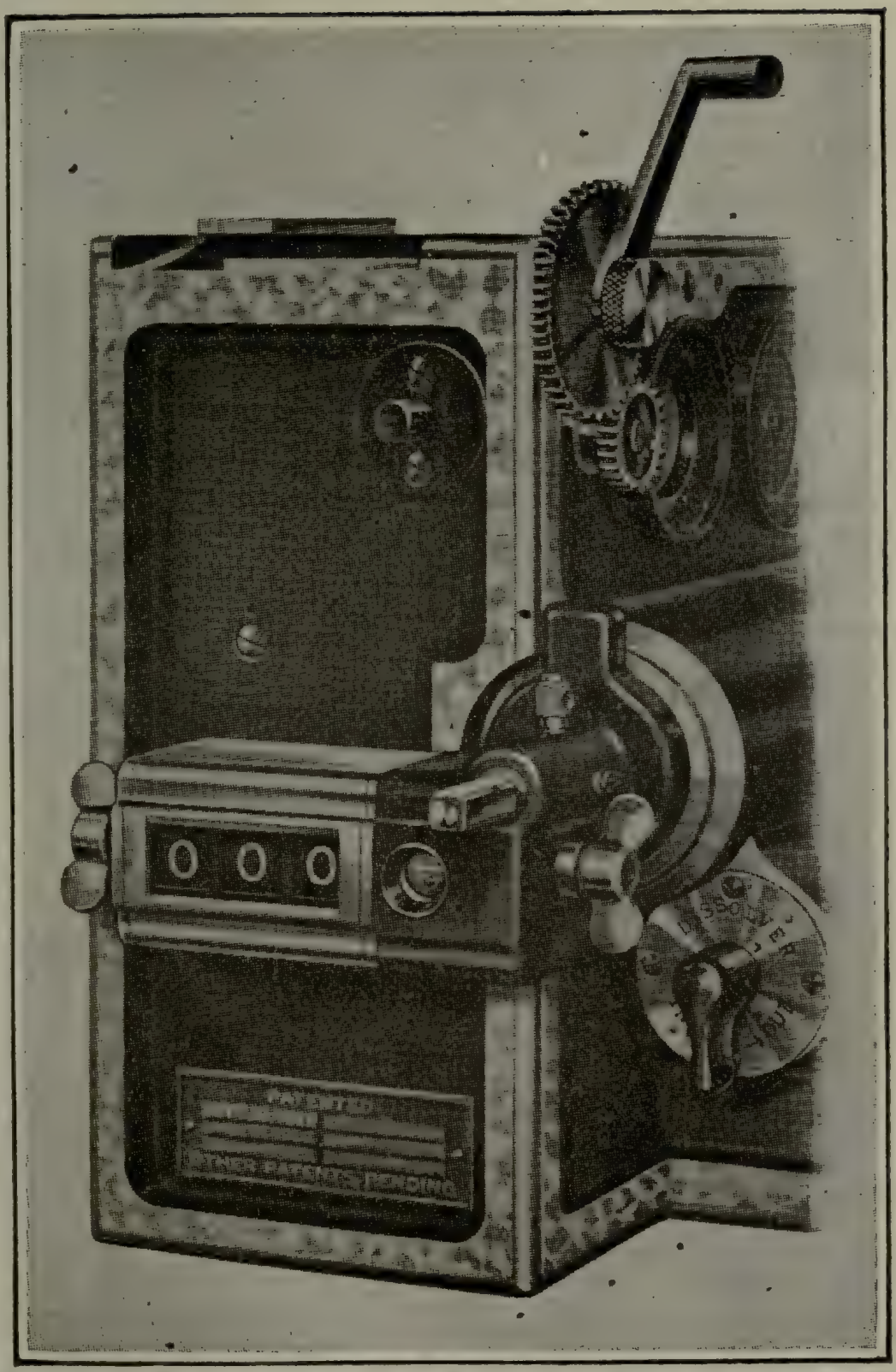
an aperture frame corresponding to the exact dimensions of the photographing aperture, thereby giving the same marginal lines or limits of the field to be photographed and insuring absolute accuracy in focusing. When the camera is shifted to the extreme

left side of the tripod, by means of a special sliding base arrangement, this aperture occupies the same optical axis as the photographing aperture when operating. An extension sleeve is provided which projects rearwardly to allow the insertion of a magnifying lens for the purpose of assisting the focusing of the object feature to extreme sharpness. Focusing by the use of the ground glass is thus accomplished without the waste of time or film, and without opening the camera.

Secondly, by measurement from the focal plane to the feature object to be photographed. Measurements are carefully noted in the graduations in the lens mounts which may be set to the line indicating the corresponding distance.

In order to follow any given bit of action with precision, the finder of this camera is provided with lenses that are matched with the photographing lenses.

The camera is provided with an adjusted shutter which consists of a principal disk and an auxiliary disk. The principal disk is mounted on the main shaft of the camera. It has a fixed minimum opening of 170 deg. radially slotted within the disk. The auxiliary disk has a projecting shutter segment of 170 deg. and is mounted on an auxiliary shaft carried within the main shaft of the camera. It is used to change the size of the opening in the principal disk when reduced time or exposure is required. The shutter is adjusted without opening the camera. The adjusting mechanism is operated by means of a pinion and registers the degree of shutter opening on a



Some of the details of the Bell & Howell camera, including Veeder counter, single picture crank for careful trick work, and dissolving control.

graduated dial. The shutter index dial is surrounded by a narrow ring which, when turned to the left, locks the camera mechanism.

The film movement of the Bell & Howell consists of the film feed and take-up sprocket, and the shuttle mechanism. The sprocket performs the double service of continuously drawing the unexposed film from the forward compartment of the magazine and delivering the exposed film to the rear compartment, where it is automatically rewound. The shuttle comprises: 1st.—The shuttle bar carrying the engaging pins which impart the feeding motion to the film. 2nd.—The register leaf forming the guideway for the film before the aperture. 3rd.—The pilot register pins which cause the accurate register of the film before the exposing aperture. Their specific function is to prevent inaccurate spacing, since an error in spacing to an infinitesimal degree causes unsteadiness on the screen in the projection of the picture. 4th.—The aperture plate against which the film is brought to register before the exposing aperture is mounted to the register leaf mounting and is in fixed relation thereto. The opening in the aperture plate definitely establishes the marginal limits of the picture. Its rearward surface forms the seat against which the film is held in contact by the register leaf during the exposure, thereby accurately locating the film in the focal plane.

The film movement mechanism thus described provides for the free travel of the film from the magazine through the camera and back to the magazine. The film is not brought into rubbing contact with the

mechanism at any point—no friction or tension is applied to it—no marginal guide rails contact it at the sides.

Like all leading cameras, the Bell & Howell is provided with an automatic dissolve mechanism which dissolves an established length of 64 pictures or four feet.

The magazine is made of aluminum cast in one piece and is of the double compartment type. It is provided with dust and light-tight screw caps or covers. The base of the magazine has suitably shaped matching grooves which correspond to the grooves constructed on top of the camera for the purpose of forming a light-proof mortised joint. When in proper position for operation, the magazine is secured to the camera by means of a clamping screw contained within the magazine. The two light valves placed at the openings where the film passes from magazine to camera and vice versa, are automatically closed tightly by the action of a spring and plunger co-acting with the valve plates, all of which is contained within the magazine. A corresponding plunger co-acting with the door plate contained within the camera automatically opens the valves for the free passage of the film when the camera door is closed. The magazine carries 400 feet of film.

The masks for this camera are made of thin bronze plates in matched pairs, the shorter for use before the focusing aperture and the longer before the photographic aperture. The purpose of the shorter mask is to indicate the limits of the field image on the ground glass in the focusing aperture, thereby

defining with accuracy the identical field limits which will result from the use of the longer mask before the photographing aperture. This feature insures the utmost accuracy in masked pictures.

A shutter index, film marking punch, and film footage dial complete the regular equipment of the Bell & Howell.

Now it is a fact that no camera has as many accessories for special results as the Bell & Howell. There is the hand dissolve attachment, which is indispensable where dissolves, fade-outs, or visionary effects of various lengths are to be made. With this device, diminishing or increasing exposures of any length can be made independently of the automatic dissolve built in the camera. It consists of a gear with suitable operating handle and is held in position on the operating side of the camera meshing with the shutter control pinion and can be detached at will.

The camera picture and footage recorder serves a two-fold purpose and entirely eliminates the uncertainty in dissolve, visionary and other special working requiring a minute check on the individual pictures exposed. By tabulating the footage and picture lengths when the dissolve or fade-out is accomplished the operator is enabled to establish the point to the exact individual exposure on the film where increased or decreased exposure began or ended. This counter also indicates film footage up to 1,000 feet.

The Bell & Howell can be fitted with a small electric motor so as to eliminate hand cranking. This motor is compact and has reversible and variable speed characteristics. It is attached at the rear of the

camera. The driving speed is anywhere from 1 to 32 or more frames per second.

A centrifugal governor of extreme sensitiveness insures uniform operation, compensating for fluctuations in the supply voltage and at the same time responding instantly to the changes of speed as desired by the operator when using the motor drive. For instance, the reduction or increase of speed of from 24 pictures per second to 4 per second or vice versa, may be made instantly. The operation of the driving motor is said to be absolutely free of all vibration and eliminates the unsteadiness of turning, which is a factor of trouble when operating by hand. In this connection it dispenses entirely with the human element and the accompanying variations, and completes the chain of mechanically-operated apparatus for photographing which further insures the quality of the output.

As for the various vignetting devices, double-exposure attachments, extension bellows and so on used with the Bell & Howell, these are more or less duplicated with other professional cameras, hence they will be treated in a separate chapter.

The Pathé Camera and Other Standard Types

Aside from the standard cameras already described, there is the Pathé studio model, with outside magazines, and the Pathé enclosed-magazine camera. Both these models have all the features that go to make for professional work and are widely employed throughout the entire world.

Then there are the Pittman and the De Franne cameras of American manufacture, which follow the

general lines of a British camera known as the Preswitch, at least so far as external appearance is concerned. Both are good cameras for professional and semi-professional work, taking 400 feet of film at one loading and being provided with an automatic dissolve. They are rather tall and narrow cameras, with a wooden case bound in metal.

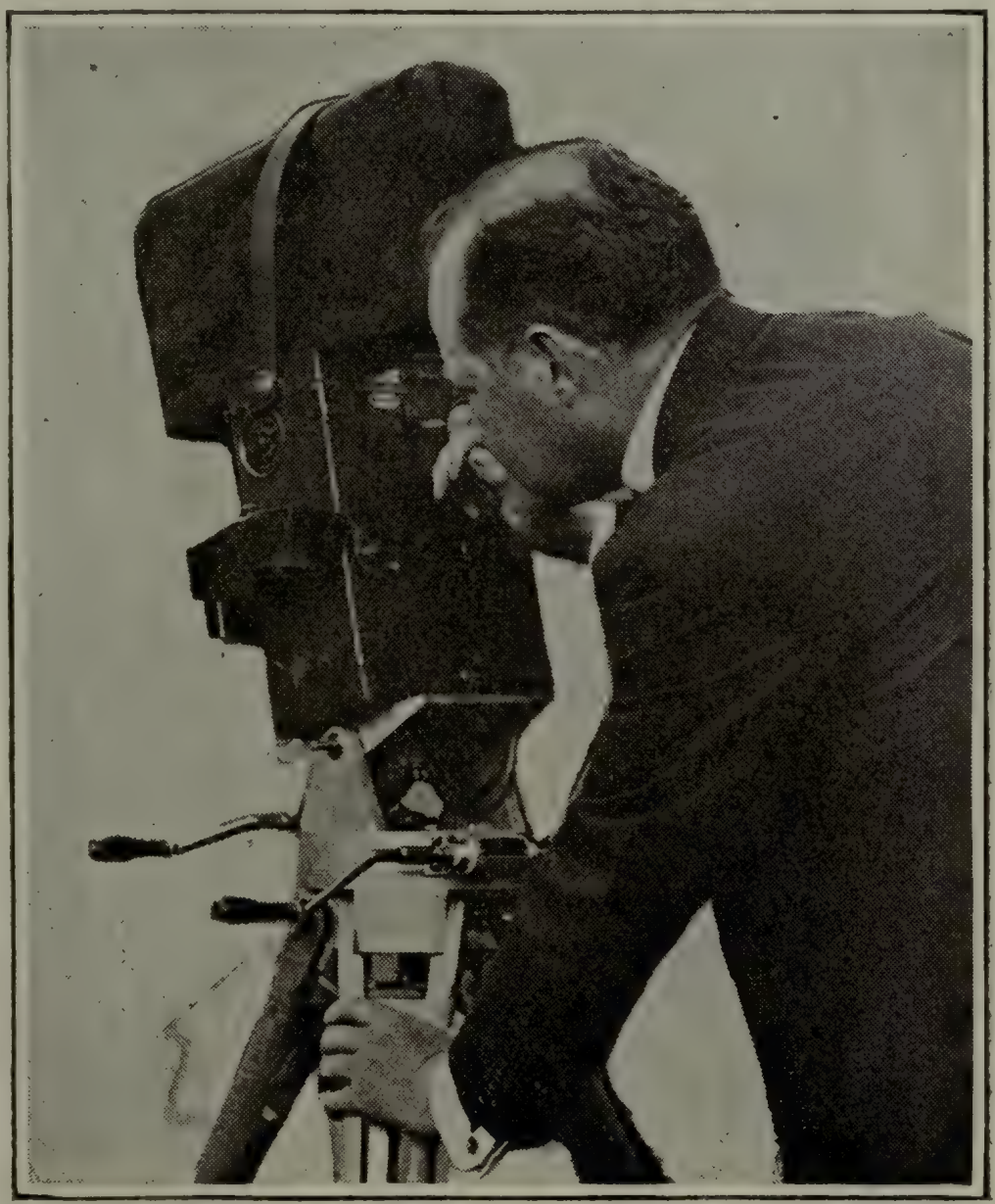
Of the less expensive British cameras there are the Ensign and the Butcher models, which are small cameras intended primarily for amateur work. Either of these takes 200 feet of film at one loading. In some cases the film is placed on daylight loading spools that do away with the necessity of magazines and a darkroom. Then there are the Williamson and the Moy cameras, intended for serious work. These cameras are of the tall and narrow wooden case type, similar to the American Pittman.

The Akeley—An Unusual Camera for Unusual Work

For following rapidly moving objects, such as airplanes and birds and race horses, the usual camera, mounted on the usual tripod, is by no means an ideal instrument. Furthermore, the usual camera has certain limitations which preclude its convenient use for such subjects, and right here is where we come to a camera that has been designed for recording the rapidly moving object and keeping up with said object. That camera is the Akeley.

The Akeley Camera is different from all other cameras, and stands in a class by itself. Let us begin with its tripod head, which forms a vital part of the

camera design. The tripod has not a single thumb-screw adjustment, yet it is the quickest adjusting tripod extant and locks rigidly in any position. It is the lightest, yet is rock steady. It is the only

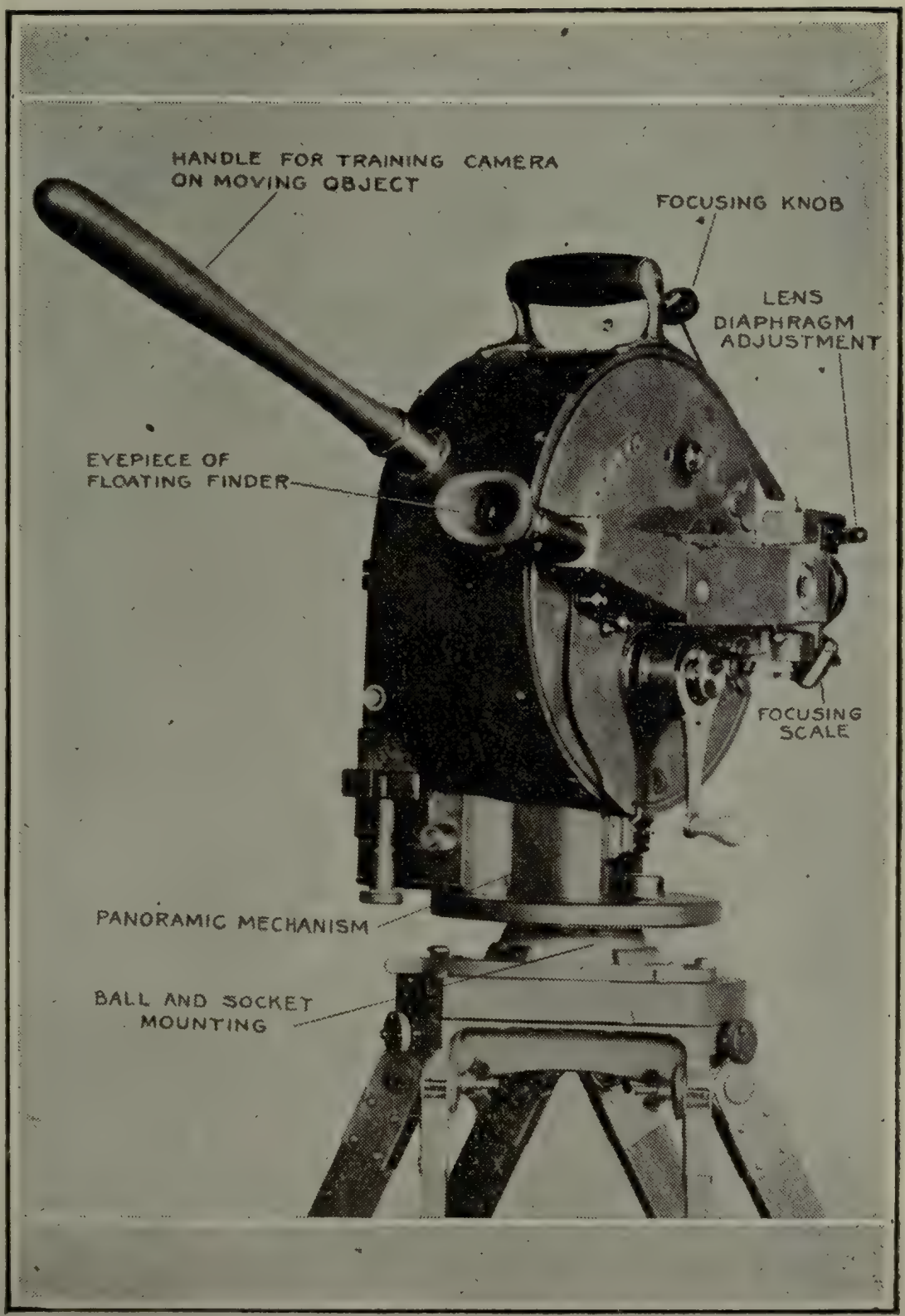


Cameraman focusing a scene with a Pathé studio model camera. Like the Wilart camera, the Pathé is cranked at the rear.

adjustable tripod with trusses. The Akeley Camera is the only camera that can be orientated in any direction with but one handle—the long handle at the rear of the camera, which is shown in the accompanying illustrations.

The case of the Akeley is round, with a handle at the top for carrying the camera about. The magazines are arranged for the full spool and take-up spool combined, and fit into the round case with very little space to spare. The shutter of the Akeley consists of a revolving band with a slit in it, similar to the focal plane shutter of the usual reflecting type camera. This shutter can give an opening of 240 degrees, which is unapproached by any other camera. The movement calls for the shortest loops and there are no sprockets in the camera box, the main sprocket forming part of the film magazine. The emulsion side of the film does not come in contact with any parts that might scratch it throughout the entire route of film.

Now one interesting feature of the Akeley Camera is the focusing arrangement. Matched lenses are used as in other cameras already described. However, these matched lenses are arranged in such a way that as the image is focused in the finder, while looking through the eye-piece fitted with the magnifying glass, the same movement also focuses the lens that does the photographing. Thus the cameraman can follow up the focus while taking the picture. Furthermore, the finder is so mounted and hinged and provided with a prismatic reflector that the finder can be made to follow any object with the matched lens of the



The Akeley camera, with the leading features indicated. This camera is especially intended for following rapidly moving objects by means of the long lever attached to the case.

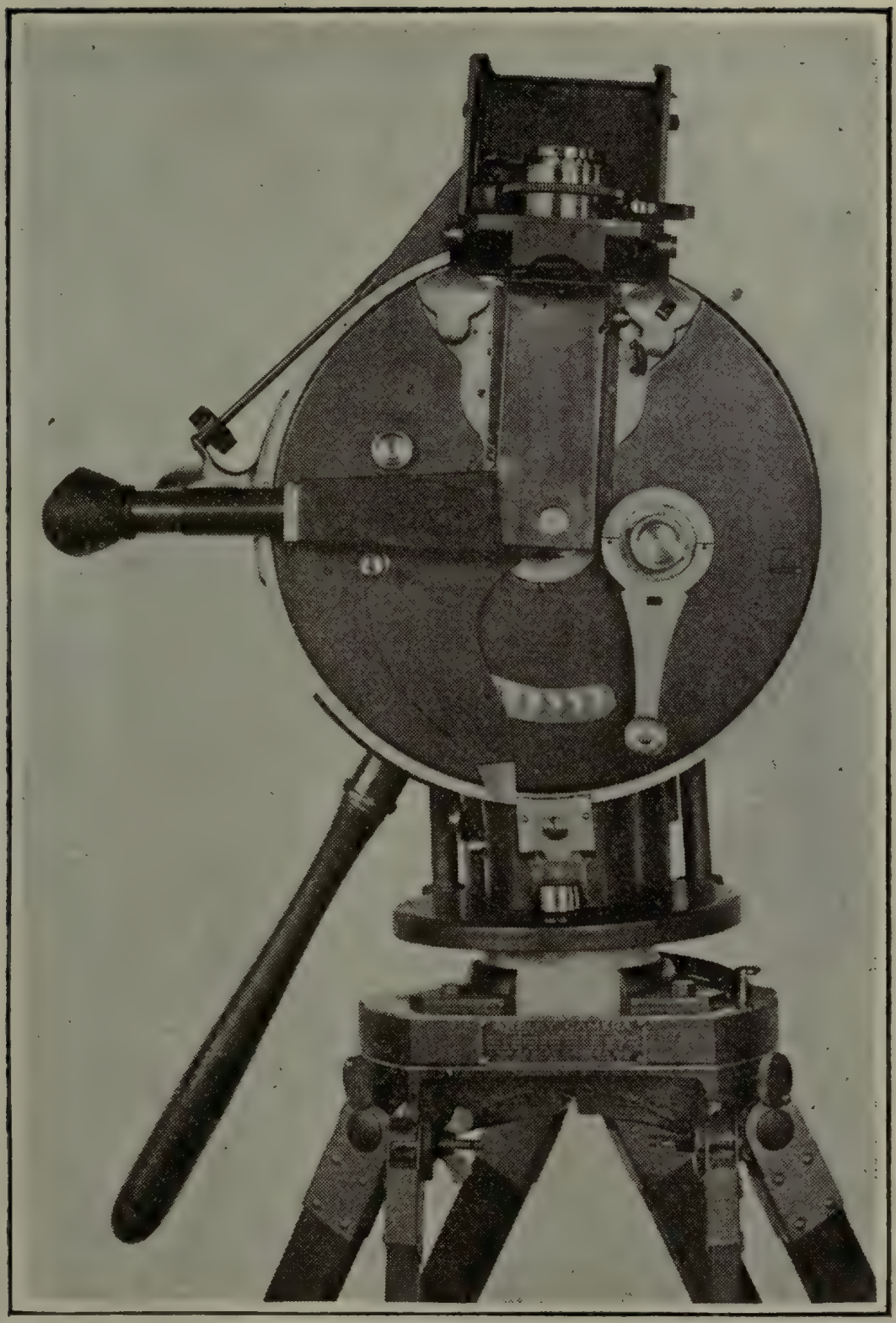
camera, while the eye-piece remains in the same position so as not to inconvenience the cameraman. This feature is known as the floating finder.

The handles on the Akeley Camera are hinged so that they can be folded back and out of the way, and under no circumstances is it possible for the cameraman to start out on a job without his means of cranking the camera.

But the main feature of the Akeley Camera is its use in following rapidly moving objects by means of long focus lenses. In the "Race of the Age," the great picture taken of Man o' War in his great race, the renowned horse was filmed by means of two Akeley Cameras from start to finish, without a break and keeping the subject in the center of the screen at all times. One camera was equipped with a 6½-inch lens, while the other had a 12-inch lens.

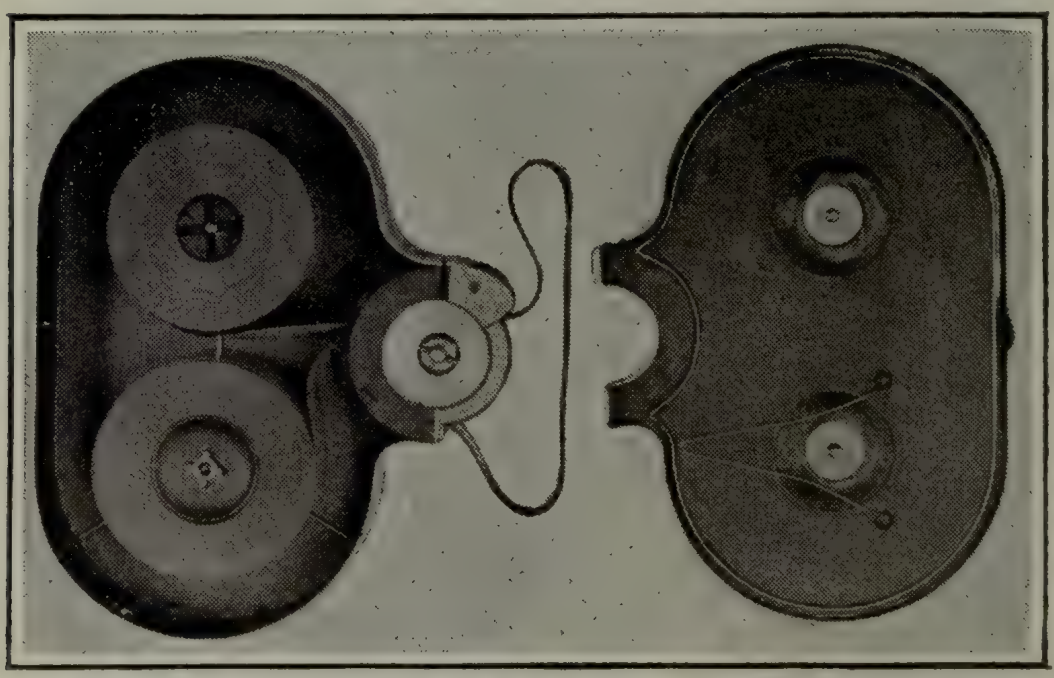
It is best to set up the Akeley Camera at the center pivotal point of the track on which the object is moving and to use the 6½-inch lens to bring the object close-up. By doing this the speed of "panning" is greatly reduced and, therefore, made easier, as the object travels slower across the field than it would when one is using a 2-inch lens and attempts to set up with a shorter radius.

When the Akeley Camera is "panned" and kept on the object with the optical axis of the lens always pointing towards the object taken, it is equivalent in results to the object and camera standing still. The only change in results is that the background is moving at the equivalent speed at which the object goes forward, the results of this on the screen being that



Akeley camera tilted to the extreme upward position, so as to demonstrate the remarkable flexibility of this equipment, which is used in filming rapidly moving objects, such as airplanes, racehorses, and wild life.

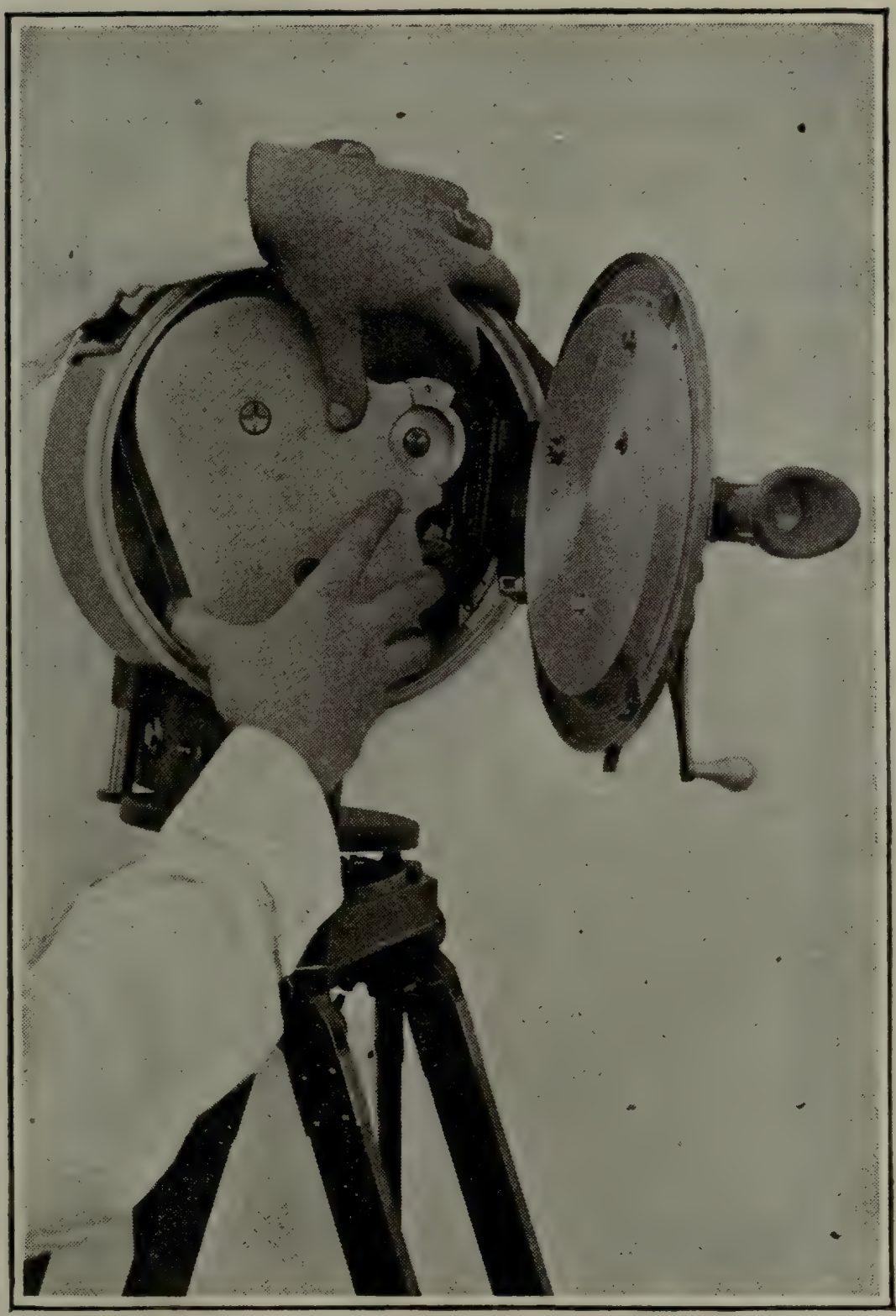
the object is sharp, while the background travels across the screen in a blur. It will be seen that by being at the pivotal point of the arc of the track the object when circling the track is always on the screen. If the object is traveling on a straight track and it is followed by the "pan," the result on the screen would be that the object when first coming toward one would be small, increasing in size until it was exactly oppo-



The odd magazine of the Akeley camera with cover removed and shown at right. The magazine has the master sprocket.

site and then diminishing in size until it went away, and would not have such a pleasing effect as when following it on a circular track where the distance from the camera is maintained.

As already stated, the panoramic effect is produced with the Akeley Camera by means of the long handle at the rear of the case. No matter in which direction



Akeley camera opened, showing how the film magazine is inserted. The shutter of this camera is of the focal plane type, consisting of a belt with a slit, revolving about the inside casing.

this long lever is pushed or pulled, the camera follows in a nice, easy, steady and positive movement, due to a train of gears and a fly-wheel arrangement in the base of the camera. The movement may be up or down or diagonally, and the camera will tilt over a range of 140 degrees, which is not attained by other cameras.

All in all, the Akeley is unique in its field, and for that reason it has met with approval of certain cinematographers who specialize in the recording of sports, wild life, military events, races, and so on.

So much for cameras. Day after day new models make their appearance so that there need be no danger that the needs of the cameraman, whether amateur or professional, will not be met. Aside from the camera, a tripod is necessary, together with special lenses and attachments, the description of which is better left for the following chapter.

Chapter III.

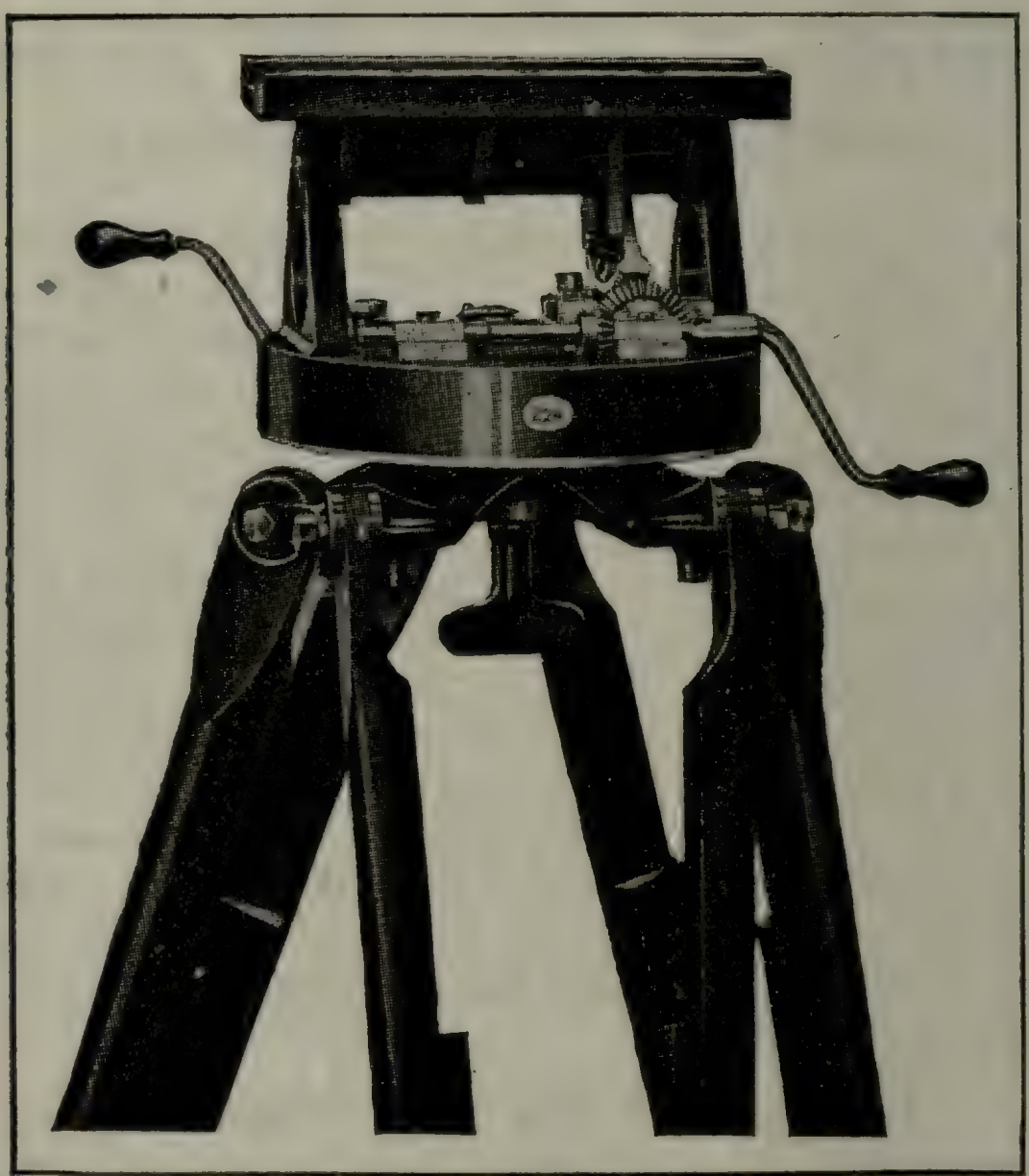
TRIPODS AND OTHER ACCESSORIES FOR THE CAMERA

THE motion picture camera by itself is seldom a complete instrument. It is true that there are certain types of cameras that are self-contained, and do not even require a tripod. These cameras are driven by a self-contained pneumatic motor, operating off a number of compressed air flasks contained within the camera case, a small electric motor, or even clockwork, in any event eliminating the necessity of hand cranking. Such cameras are sometimes provided with a small gyroscopic stabilizer, in order that they may be held more steadily. However, these hand cameras are a rarety, and ninety-nine out of every hundred cameras require at least one accessory, namely, a tripod. In fact, the tripod is to the motion picture camera what the tender is to the steam locomotive, and we may well say that the best camera is no better than its tripod.

The Question of a Rigid Foundation

Remember, motion pictures are nothing more than numerous pictures projected one after the other on a screen at such a high rate of speed that the phenomenon of persistence of vision causes the eye to carry over from one picture to the other, so to speak, without a gap being apparent. Now if these pictures do

not fit perfectly one over the preceding one, we do not have perfect register and the eye soon detects a



The Bell & Howell tripod, representing the essentials of a good solid tripod for serious work.

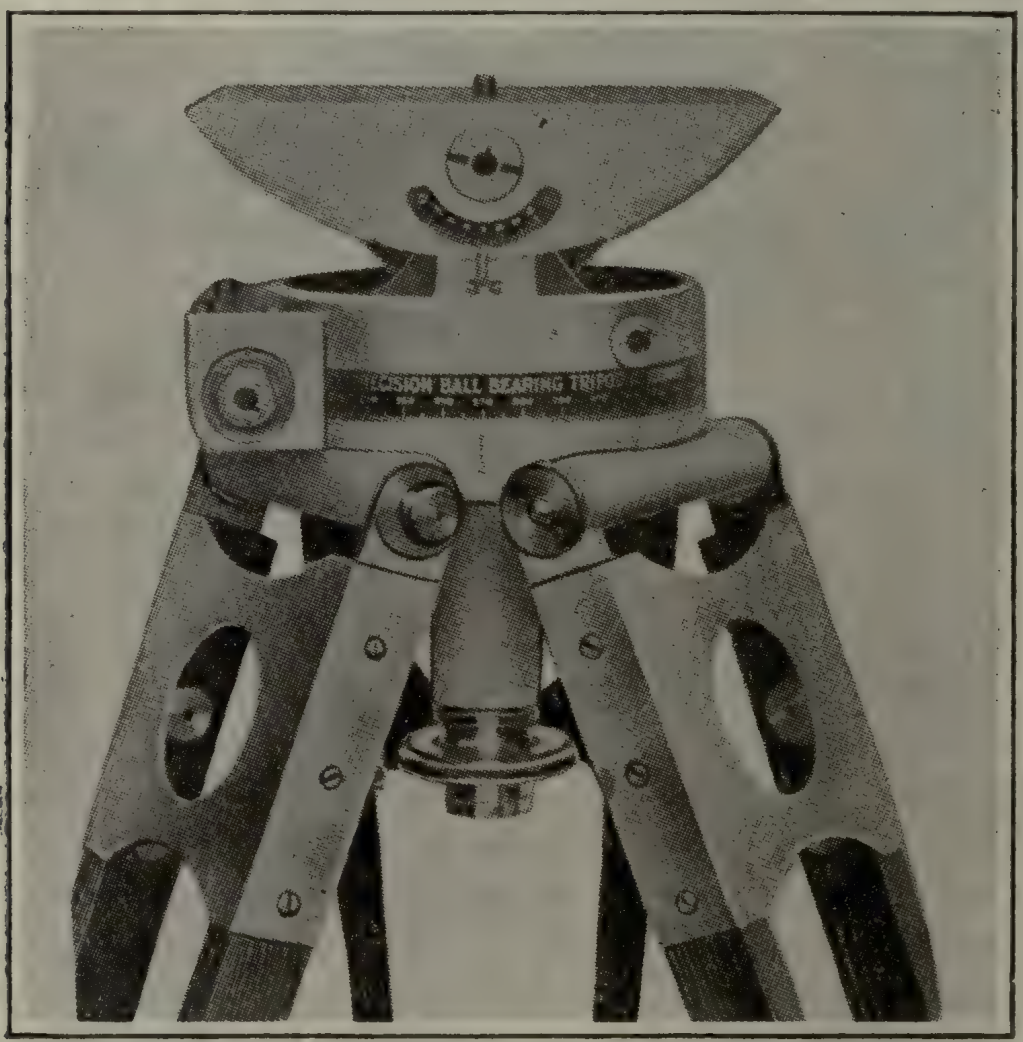
blur due to this lack of register. So it is absolutely essential to have the camera rigidly held in position while taking a picture, so that there may be no move-

ment, swaying, jumping, or shifting of the camera.

The need of a rigid foundation for the camera is what accounts for the heavy and elaborate tripods in use. Besides, the cameras are heavy and there is usually some vibration arising out of their operation, which must be absorbed by the tripod. It is only too often the case that the purchaser of a camera, having bought the best camera which he could afford, will skimp on the tripod, with unfortunate results. A good tripod has to cost a good deal—anywhere from $75 to $200. It is unavoidable. Solid wooden legs, well shaped; good fittings to tighten the various members into a rigid structure when set up ready for action; carefully cut gears for the panoramic and tilting movements; a carefully planed metal rest to receive the camera—all these features cost money to produce.

To purchase a cheap tripod—except where the low cost is due to circumstances rather than the absence of quality in the product—is only to court poor results even with the best camera. The author speaks from practical and sad experience, for he started his filming activities with a good camera but with an inexpensive tripod. Said. tripod had cast gears, a tiny aluminum head, and flimsy legs of light wood. The tripod was light to carry about, and that feature, coupled with the low price, made it an attractive proposition. But the disappointment of having several hundred feet of otherwise perfect negative turned down by the various film companies because there was too much "play" or "jump" in the pictures soon convinced him that lightness and cheapness were

not desirable qualities in a motion picture tripod. The pictures, when projected on the screen, rose and fell, in wave-like motion, very much after the fashion of pictures taken from a small boat in a rough sea.



The Precision ball-bearing tripod, which is widely employed in the art, because of its excellent design. The tilting and panoramic movements are calibrated for reference purposes.

So it is well to pick out a tripod that is sufficiently heavy to be rigid and sturdy. The standard motion picture tripods are almost invariably provided with

what is known as the tilting and panoramic head. That is to say, by turning one crank the head which carries the platform can be traversed or swung about to any point on the horizon, while another crank causes the head to be tilted up or down, so that the camera can be pointed at any angle within the limits set. A combination of both movements enables the camera to be trained on any object and to follow a moving object while taking pictures.

The main thing in picking out a tripod is to make sure that it stands rigidly on its three legs, and that the legs can be locked in position so as to preclude all play or slippage. The next step is to examine the tilting and panoramic mechanism and to make sure that the gears mesh properly and that there is no play. The better types of tripod have due provision made for adjusting the gears so as to take up play when wear occurs. The next requisite is to make sure that the platform is amply large and properly shaped to take the camera with which it is to be used.

The camera is mounted on the tripod head and held in place by a thumbscrew that comes up through the center of the platform and engages with the screw hole in the base of the camera. There are certain exceptions to this arrangement, such as a special tripod sometimes used with the Pathé studio camera, the Bell & Howell, and the Akeley camera. Some tripods are so designed that the thumbscrew can be readily driven home into the camera screw hole, while with others it requires quite a bit of exasperating effort to get at the thumbscrew and then find the hole

in the camera resting on the tripod platform. The better types of tripod simplify the fastening of the camera on to the tripod platform as much as possible.

Perhaps the most popular type of tripod in general use is the Ball Bearing Precision Tripod, which represents the embodiment of many new and desirable features. Furthermore, the description of this might well serve as a specification for judging tripods intended for serious work.

First of all, the worms and worm wheels of the Precision Tripod are entirely enclosed, thereby obviating what has always been a serious proposition with the average tripod, namely, having sand and grit accumulate on the surfaces and being ground into the mechanism. The author has a rather small and simple tripod which has exposed gears, but he always keeps its head covered with a duck cover held in place by means of a strap when the tripod is not being used. In this manner there is no opportunity for dust and dirt to get into the mechanism.

Then the Precision Tripod is ball-bearing throughout. The panoramic top and also the tilt top are both graduated in actual degrees. There are no projecting shafts and knobs on the tripod which are liable to interfere or get bent or broken off. The tripod handles are attached by means of a spring latch and are inserted into hollow shafts. The entire top can be released and swung round quickly without disengaging the worm from the panoramic worm wheel, simply by releasing the milled nut underneath one-quarter of a turn.

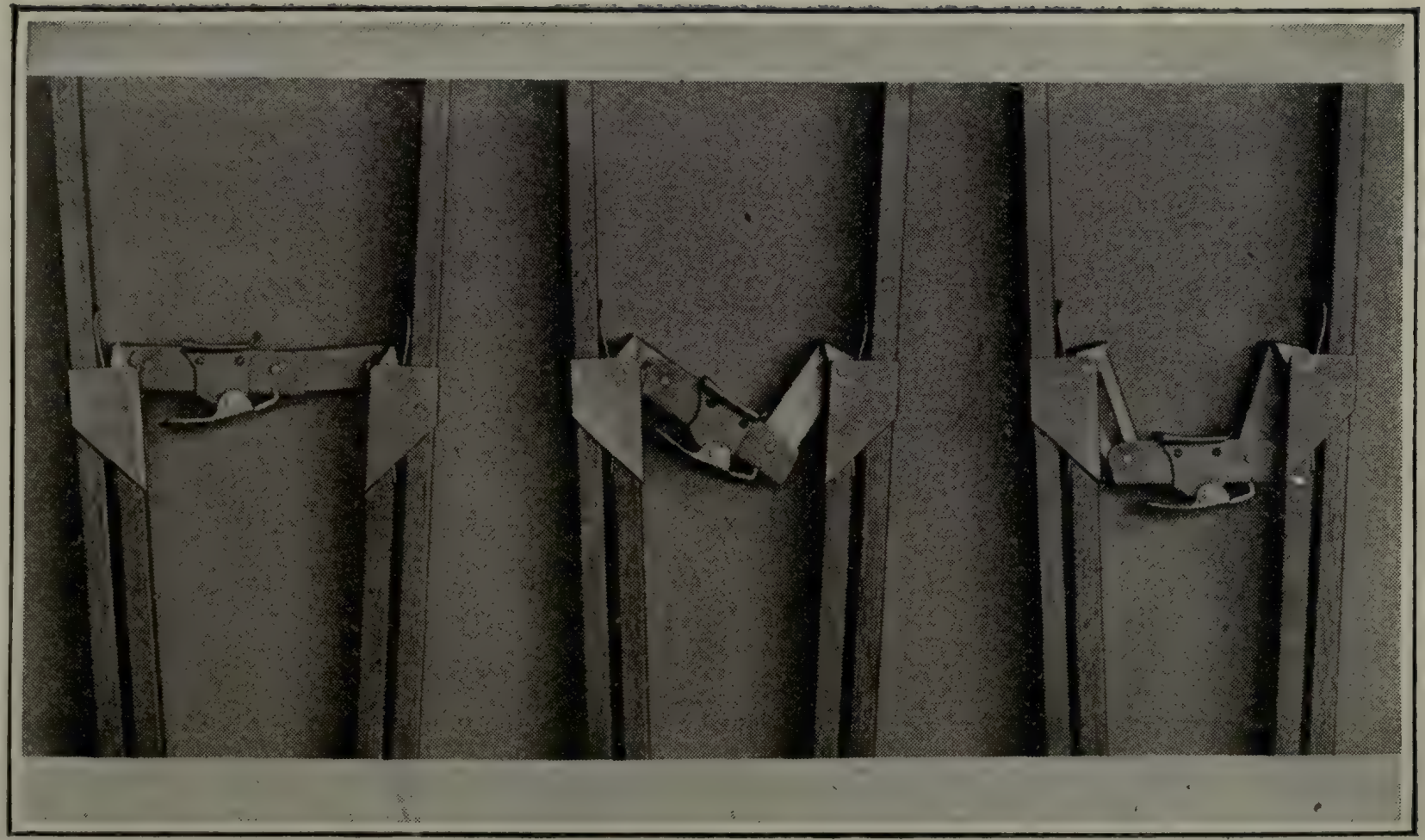
The legs are of polished beechwood, properly de-

signed, with a wide spread at the top. However, they are fastened to the tripod by metal locks and not by wood. The top of the legs are braced with a metal sector between the two portions, the metal sector being cut out to make it light and at the same time absolutely rigid.

Another feature which is unique with this tripod is that the centerpieces of each leg terminate in an aluminum chuck with a brass binding nut which can be released and the point removed and a new one replaced within a few moments' time. The worm wheel and tilting top sector are cut in bronze, not in aluminum. Ample adjustment is allowed at every point where wear is liable to occur. Adjustment is made by releasing the lock screw and taking up a quarter of a turn or so every three or four months or as needed, in the case of the bearings of the tilting top which is suspended by means of steel cones. The adjustment on the tilting top sector consists of two bronze wedges, regulated by means of flanged screws, which are used to take up any wear that may occur. End play in the worms can be taken care of instantly from the outside and the entire top can be disassembled in 30 seconds for thorough cleaning at intervals. The Precision Tripod weighs about 23½ pounds, and the height extended is about 80 inches.

The Akeley Tripod

The Akeley Tripod is just as unusual in its own way as the Akeley Camera. Thus while it has been previously necessary to make a tripod of a considerable weight in order to get it steady, the theory being,



Various stages in the unlocking of the legs of the Akeley tripod. This tripod weighs but 12 pounds, but its design is such that absolute rigidity is obtained. It can be used with other cameras, although primarily designed for the Akeley.

the heavier the tripod the steadier the filming, the Akeley Tripod has been made surprisingly light. Weight has been eliminated by a special design that makes for extreme rigidity.

The Akeley Tripod weighs 12 pounds. The head is of cast aluminum, triangular in shape. The legs are of straight grain mahogany. The wide spread at the top gives rigidity and good support. Thumbscrew attachments permit legs to be quickly removed from the head. Simple straight sticks make possible quick replacing of a substitute in case of breakage. An ingenious method of locking the legs in position is employed, consisting in trusses which, when locked, slightly bow the legs outward and give tension, which results in the remarkable rigidity. In this position the end of the truss bears against steel springs, which, bearing leather washers to prevent slippage, hold tightly against the outer and upper sticks and thereby lock the tripod. To unlock, the thumb is placed on the upper thumbpiece of lock and the middle finger presses the lock lever which releases the catch, while the pressing down with the thumb breaks the lock. By another pressure of the thumb the second half of the lock is broken, as shown in the accompanying illustration, and then this lock serves as a handle to actuate the lower leg freely up or down. While the Akeley Tripod is primarily designed for use with the Akeley Camera, it can be employed for any other camera by being provided with a special head.

Still another popular tripod is the Universal Tripod. In this type the vertical tilt is obtained by a segmental slide which is a departure from the pivot

action heads now so extensively in use. The segmental slide operates in a U-shaped cradle which gives the maximum width of bearing surface. The full weight of the camera is carried on the grooved base piece, which insures smooth, steady action when in motion. All vibration, twitching and jerky effects are eliminated. The head tilts up and down through 90 degrees. When locked it is secured at both ends of the cradle piece.

The panoramic worm box can be instantly disengaged when it is desired to turn the camera quickly to any position. The panoramic disk can be locked to prevent any accidental movement. The worm and worm gears are of special design with ample thread depth, which adds materially to their durability, and gives a high degree of accuracy and freedom from loss motion.

The lock bolt is provided with a compression screw which is depressed by the weight of the camera, so that it is easy to shift about and see when the screw engages the threads of the camera. It is a great time saver, and will be much appreciated for field and news reel work, or wherever rapid preparations are essential. Instead of turning the screw from the bottom, it is operated from the side of the head, which makes it accessible and easy to operate. Moreover, there is no danger of stripping the thread. In unmounting, the camera is known to be disengaged when a clicking sound is heard from the turning of the lock bolt. All locking mechanism on the tripod is mounted on the operating side. It is said that this tripod can be set up in ten seconds. It weighs

20 pounds. The wide spread top legs give truss strength and rigidity.

It is well for the cameraman to hold his left hand on the rear end of the camera when there is apt to be slight play in the tripod head. Resting the hand on the camera and applying a little pressure often counteracts any play that might rise out of a faulty tripod. At any rate, it is generally a good precautionary measure.

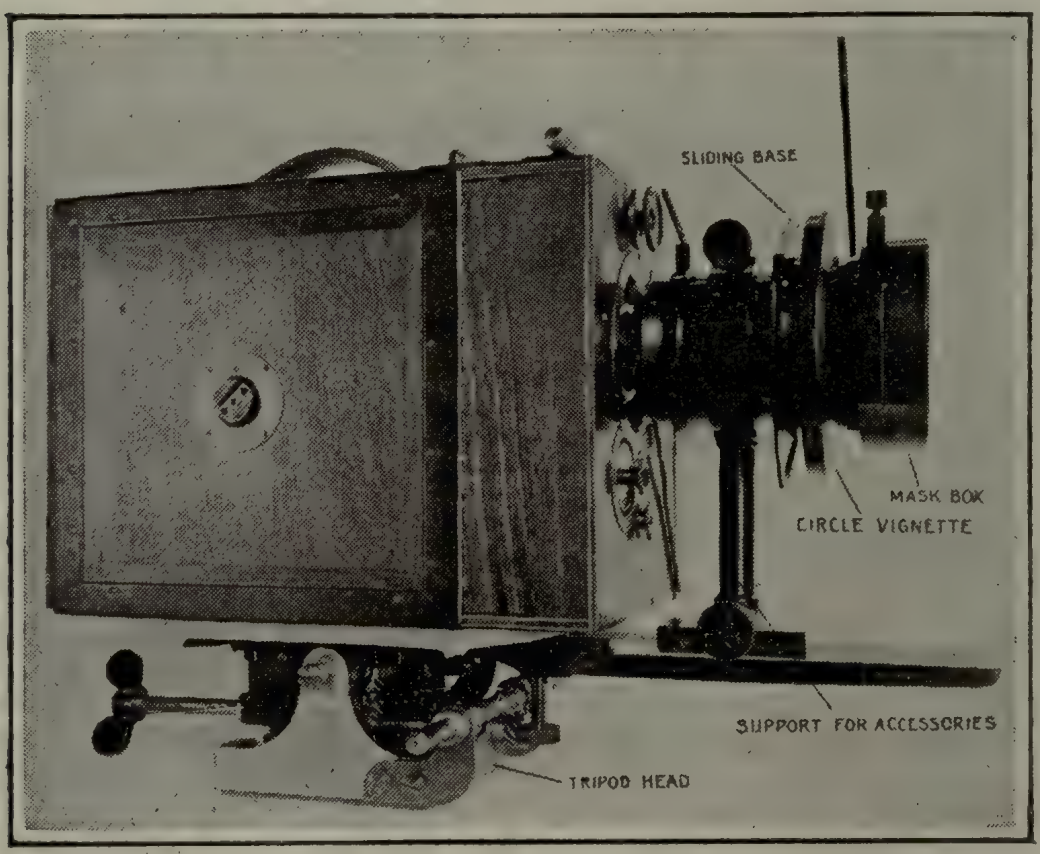
The Bag Full of Tricks

For years cameramen were satisfied with plain photography, because there was no special demand for unusual effects. Then, too, the photoplays were in their infancy and very little was spent on productions. So why go to extra expense and trouble in filming operations?

However, with the growth of the motion picture industry and the gradual development of the photoplay art, more and more special effects have been requested of the cameraman in order that the filming operations might keep apace the progress made in scenery, direction, acting, lighting, plot, and so on. Today the cameraman must have a whole bag of tricks, so to speak, in order to make his pictures as attractive and even as unusual as possible. Obviously, most of these special effects call for numerous accessories, which it is our purpose now to take up in detail.

Probably the best known and most widely used of all the motion picture camera attachments is the round closing and vignetting device, usually called

the iris. It is shaped like the ordinary iris diaphragm of the camera lens, only that it is larger and the blades are so constructed that they close entirely without leaving even a pinhole in the center. The usual mounting is upon a sliding base and extension tube. The extension tube is required to permit mov-

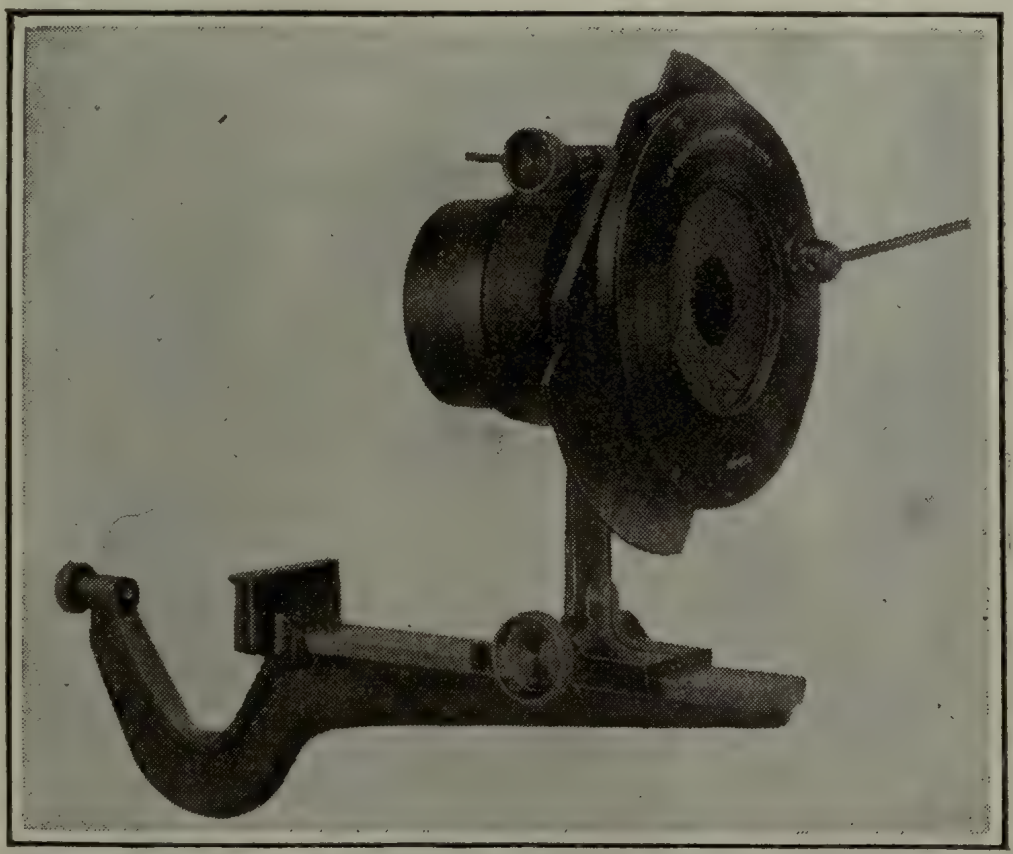


Debrie camera with special tripod extension attachment to carry circle vignette and mask box.

ing the round closing dissolving and vignetting device toward or away from the lens, thus maintaining control over the sharpness or diffusion of the circle effects required when circling in or out.

Another effect which the sliding base and exten-

sion tube service for is vignetting either head or bust close-ups. The cameraman will find the sliding base absolutely essential when he is called upon to feature the expression of a certain actor who is not in the center of the picture. Especially is the device important if for any reason the cameraman cannot change

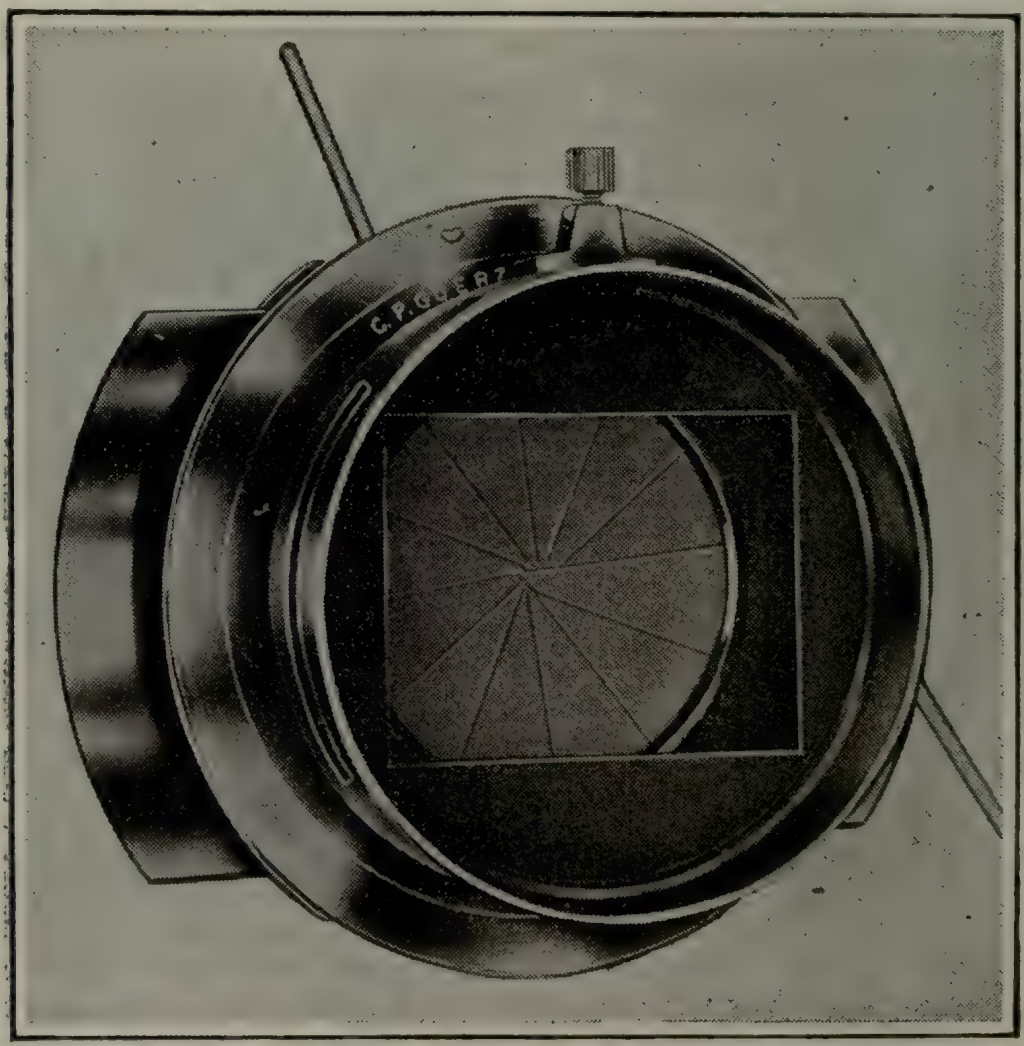


Goerz circle vignette mounted on special carrier which is intended in this case for use with the Bell & Howell tripod

the position of his camera; for by means of the sliding base he can move the round closing dissolving and vignetting device into any required position, and thus make round closing vignetting or dissolves anywhere in the picture, center, top, bottom or left, and in any of the four corners.

With Sliding Base and Extension Tube

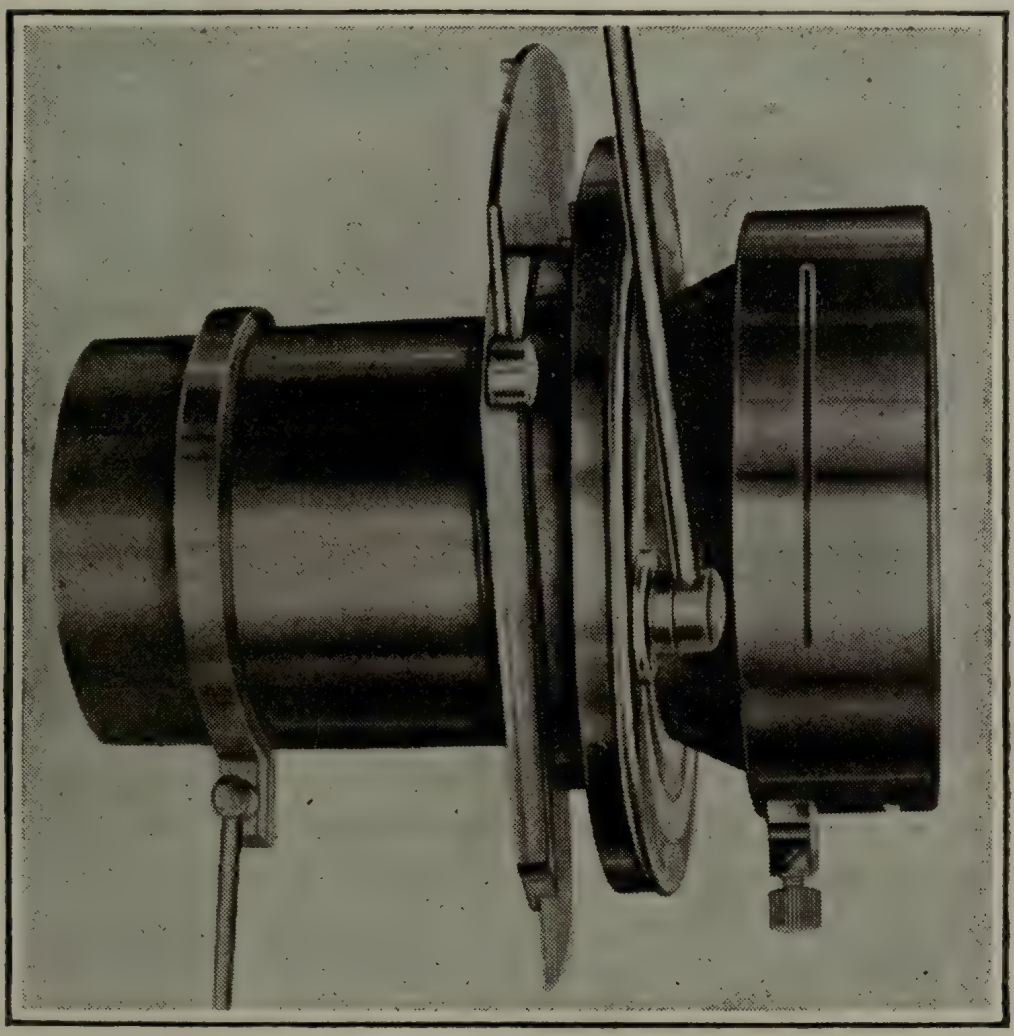
When using the sliding base the length of the extension tube is shortened so that the round closing dissolving and vignetting device clears the size of



Front view of Goerz mask box fastened to a Goerz vignette. The leaves of the vignette are shown completely overlapped, so as to shut off the light completely.

the picture. When the cameraman wishes to make five vignetted close-ups, four to be near the edges and one in the center for introducing the actors on the

title, the round closing dissolving and vignetting device is used at small aperture. The actor is first circled in for a certain length of film, then circled out. The film is then run back and the same method



Side view of the Goerz mask box and the circle vignette, mounted on a sliding base and an extension tube for the necessary adjustments.

repeated with the round closing dissolving and vignetting device set near the edges of the picture and so on until each close-up of the actors is made in whatever make-up they are to appear in the pic-

ture. As many as eight close-ups have been made on the same strip of film in this manner. For this purpose the round closing dissolving or vignetting device is fitted with a stop pin attachment, which allows the lever only a limited movement, or, in other words, the aperture of the round closing dissolving and vignetting device may be set for any diameter required.

In the case of the Goerz round closing dissolving and vignetting device, the aperture is 2⅝ inches, while the largest outside diameter is 4⅝ inches. The sliding movement of the sliding base is limited, its entire length being 5¾ when kept in the center. It can be worked either by gear action or set by hand. A special round closing and vignetting device is made to order, having an aperture of 3½ inches and an outside diameter of 6 inches. The sliding base for this is 7 inches long. The extension tube closed measures 1¾ inches, extended 3 inches, and is arranged to fit on various makes of cameras. In some cameras where attachment to the lens mounting is not practical, the vignetting attachments may be held in front of the lens by a system of supporting rods, as shown on page 132.

The usual iris for the Bell & Howell camera is the Thalhammer combination iris. By its use all the effects that are in vogue at present can be obtained, and, unlike other apparatus made for this purpose, it is claimed to allow the operator greater latitude in producing visionary and masking effects by reason of its graduated masks and unified construction. The 3½-inch iris can be operated directly by hand or indi-

rectly through a bevel gear and hand wheel, permitting greater uniformity and precision in opening and closing. The mounting, which consists of two horizontal tubular rails, clamps directly on the regular Bell & Howell tripod head. The Labrely iris, introduced by M. H. Schoenbaum in this country, is a French invention which has won its laurels practically over night. Its leaves are of a novel design that permits of an even closing movement and maintains a perfect circular opening at all times, from pinhole to full opening.

The Mask-Box Attachment and Its Uses

One of the most important supplements to the round closing dissolving and vignetting devices is the mask-box attachment. This is mounted detachably to the front thread of the round closing device. It has a rectangular opening in exact proportion to the picture size and can be adjusted to perfect alignment with the aperture of the camera. A slot cut in the mask-box on both sides enables the cameraman to insert masks of metal, cardboard or colored celluloid (green or yellow) for the purpose of making vision effects and double exposures where it is required to cut the shape of the mask to fit the scene for which a double exposure or vision exposure is wanted. It will be found more advantageous to use masks in the mask-box attachments, since they can be cut larger and are easy to trim and easy to adjust. For a certain kind of double exposure, where a perfect optical plane glass plate is used in the mask-box, arrangement can be made so that the glass

in its mounting will screw in the front thread of the mask box attachment.

The Double Exposure Device

The double exposure device is designed to produce three different effects, all of which are essential to the best pictures:

1st. When the control lever is operated the blades open or close in opposite directions. If turned at right angles it gives the effect of two sliding doors for opening or closing a picture.

2nd. The upper blade is detached from the control lever and fastened by means of a thumbscrew to the base. This leaves only the lower or longer blade connected to and operated by the control lever. When operated in either direction the effect produced is similar to the raising and lowering of a curtain in front of a scene.

3rd. The blades may be used independently. For this purpose the double exposure device is turned around and used so that the blades move horizontally towards the center. They may be set by hand to divide the stage in two or more parts for double exposures. This is used when one actor plays a dual rôle in the same scene. The diffused division line of the first exposure will blend with the one of the second exposure, thus leaving no division line at all in the finished picture. The double exposure device is attached to the front of the mask-box attachment by means of a clamp screw and it may be readily removed when not needed. This method of making double exposures is by far superior to any other

Double exposure device which may be used in a wide variety of ways. It is employed in making two or more exposures on the same film, and for various sliding door, rising or falling curtain and other pleasing screen effects.

method, as the device is sufficiently far away from the lens as to allow a larger movement and a more exact adjustment. The aperture of the Goerz double

Typical double exposure produced with double exposure device. In this case the same actor appears twice in a given scene.

exposure device, which is shown on page 119, is 2¾ by 2¾, and lines are engraved for the picture size 2¼ by 2¾ inches.

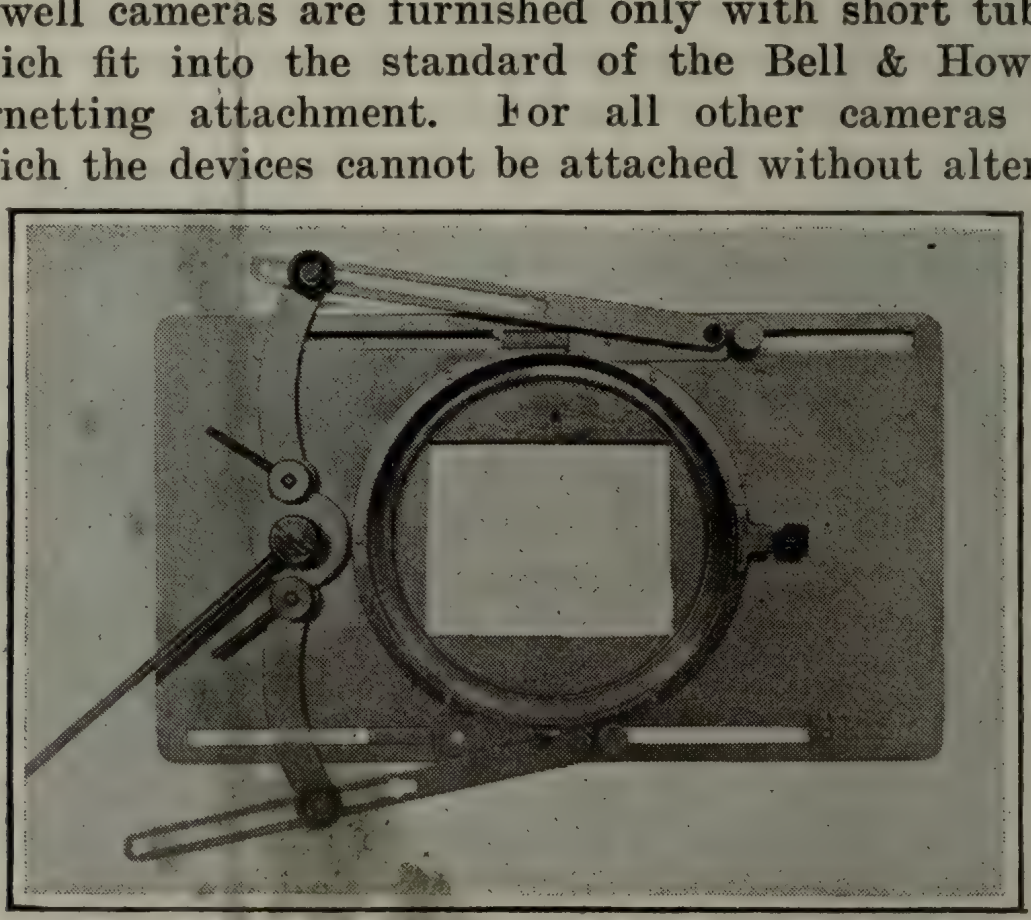
The Square Closing Device

The square closing device is an attachment designed to be used in a similar manner to the round closing dissolve and vignetting device and the double ex-

posure device. All four sides of the parallelogram move towards the center and the rectangular shape is preserved until the picture finally disappears. This device is also applied to the mask-box attachment and should be used as far as possible in front of the lens, depending upon the aperture, which is 2⅛ by 2¾ inches. This attachment can be used just for opening or closing a scene or it can be used when a man is walking towards or away from the camera, in the first case opening the attachment slowly, in the second closing the attachment slowly, always keeping the man the same distance away from the top and bottom lines, which when correctly staged will give the effect as if the camera were running on tracks and moved toward or away from the man. Some cameramen, it would seem, could improve their pictures by substituting the square closing device for opening or closing a picture, especially such pictures where a long road, railroad tracks or trestle work run toward the camera, instead of the usual round closing device. The effect of the round closing device circling in or out, although pleasing, is not always adapted to all kinds of pictures, and a cameraman as well as his director, would do well to think over what kind of devices should be used to make every scene a success. The framing, it goes without saying, can often add to or detract from a picture.

The dissolve and vignetting devices described are adaptable to any camera on the market, although in the form illustrated they are intended for the Pathé No. 1 or Studio Model, and for the Bell & Howell. The dissolving and vignetting devices for the Bell &

Howell cameras are furnished only with short tubes which fit into the standard of the Bell & Howell vignetting attachment. For all other cameras to which the devices cannot be attached without altera-



Rear view of the Goerz multiple exposure device for double exposure and trick work. This device is clamped to the usual camera tube or accessories by means of the collar and set screw.

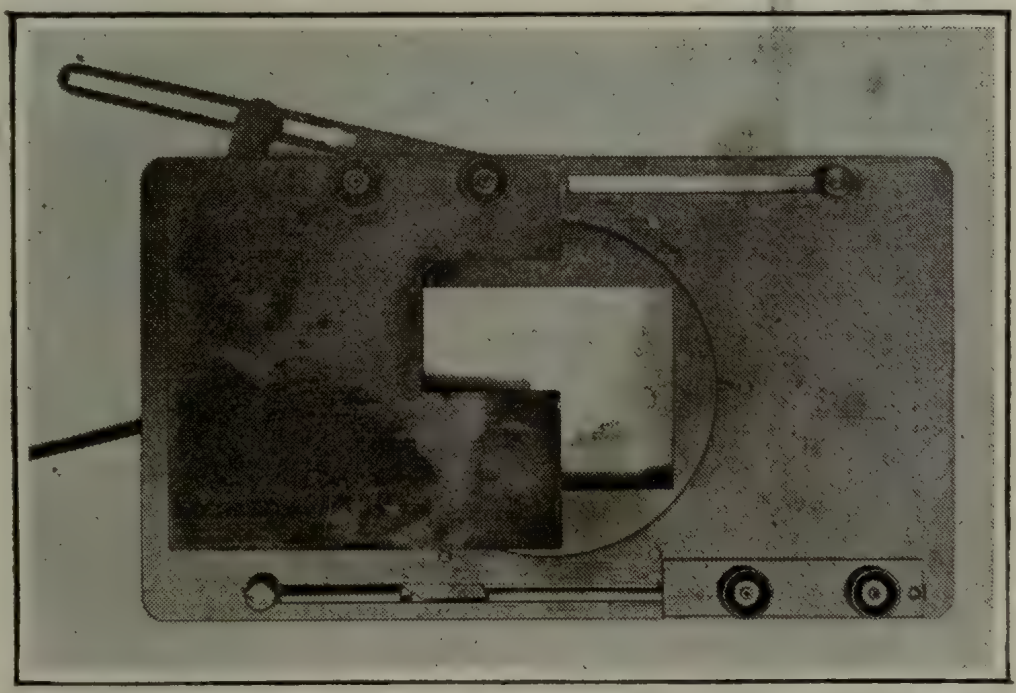
tions, a charge is made only for the tube and for the fastening device with which these attachments can be clamped or otherwise held to the frontboard.

The Goerz Multiple Exposure Device

The new Goerz multiple exposure device has met with wide approval ever since its introduction, especially with those cameramen who do plenty of double exposure and trick work. The device is slightly larger in dimensions than the regular double exposure

or square closing device, but the back fits the mask-box, as every Goerz device is standardized.

As will be seen in the accompanying illustration, which shows the instrument as seen from the back, and the next illustration which shows it from the front side, the long lever or rod is screwed into a pillar which has on its lower end a flange to which, by means of two small clamp-screws, the two semi-

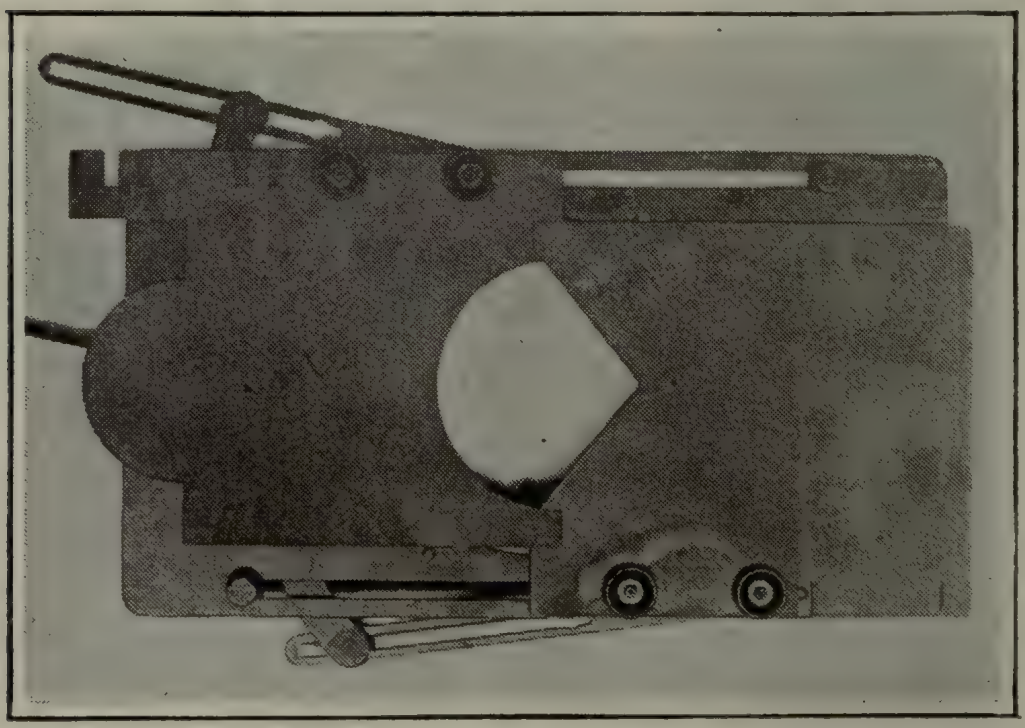


Front view of the Goerz multiple exposure device. The plates, of different designs, can be readily changed to produce different shaped openings.

circular actuating levers can be clamped independently of each other. These two semicircular levers are connected by means of pivoted thumbscrews to the straight slotted pieces, which at the other end are mounted on pivots fastened to the sliding bars, which carry the blades on the opposite side. If a clamp-screw on one side of the pillar flange is re-

leased, the long lever will actuate only one side. The movement of the blades is thus made independent of each other. The stroke of the movement can be adjusted either by setting the clamp-screw on the pillar flange or by adjusting the pivot thumbscrew in the slot of the straight slotted pieces.

The square opening can be rotated by hand and

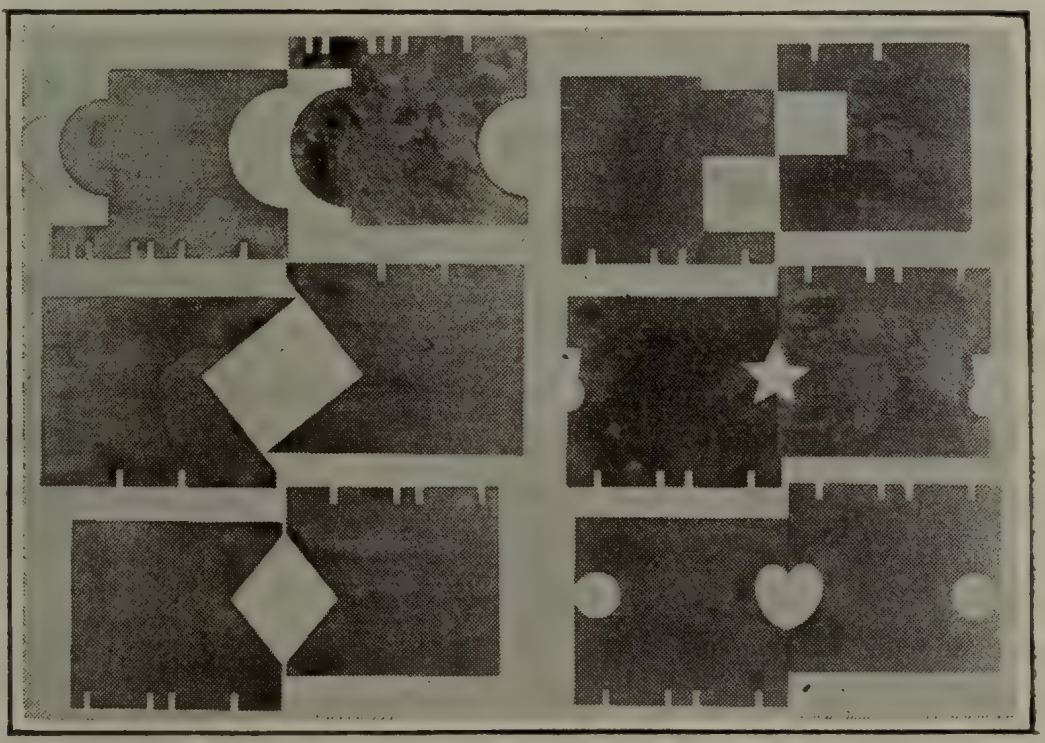


One of the many different shaped openings produced by using certain combinations of plates with the Goerz multiple exposure device.

brought in alignment with the camera aperture whenever necessary. The device itself can be rotated and clamped in position on the mask-box. In our second illustration of this device, which is a front view, the two sliding bars to which the blades are attached can be seen. To one of the bars there is attached a blade with a cutout of one-quarter the aperture, for making

one, two, three or four exposures in each frame.

Now the blades come in a variety of different styles, as will be noted in the illustration appearing on this page. These blades may be readily mounted in place on the device in order to produce any combination of openings, especially with a little ingenuity on the part of the operator. Thus two half-circle blades can be attached opposite each other, each half-



A few of the many different sets of plates or blades used with the Goerz multiple exposure device.

circle representing the small and the wide side of the aperture. The square opening can be turned now so that the half-circle blade either blocks or exposes just one rounded corner. By rotating the whole device on the mask-box, four rounded corners can be either blocked or exposed. In each case the blades can be

adjusted at will to limit the slide of the blade. The double exposure can always be made to slide into the picture gradually, not suddenly.

Then again, two blades of different shapes can be mounted on the device, one the half-circle blade and the other the rhomboid-shaped blade, for instance. The resultant shape suggests a side view of a cut diamond—a triangular base with a rounded top. Or two rhomboid-shaped blades can be attached, one of them in the reversed position, *i.e.*, with its straight edge towards the aperture. The shape thus formed represents the outlines of a house, and is used mostly for framing, blocking out undesirable lighting coming in through tree tops and causing too much halation. Either blade, however, can be dissolved separately or together.

It is but a waste of valuable space to go on with a description of the various combinations of blades that can be used; but suffice it to say that with a complete kit of blades the cameraman is never at a loss to frame his pictures in any way he sees fit. The blades are readily inserted and clamped by means of the thumbscrews to their respective carriers, and either side or both sides may be moved independently or together as the requirements may dictate.

The blades are of steel sheet, but can also be made of transparent colored celluloid whereby still other effects can be gained. These celluloid blades may be made in green, yellow, blue or white with a ground-glass finish. The operation of the device is so simple and positive that the cameraman can set and reset the blades without consulting the ground glass or

film when making double exposure or special effects.

In using the outside vignetting devices it is necessary to place them a considerable distance from the lens in order to obtain the correct degree of softness in the outlines of the picture, thus permitting light to enter the lens other than that which comes through the device, if the proper extension tube is not used. Obviously, this is undesirable if a perfectly dark ground is wanted. To overcome this obstacle, a square bellows that attaches directly to the rear of the vignetting device, the other end being clamped over the lens mount, is available when required. It is frequently employed with the Bell & Howell outfit.

The Question of Ray Filters

With the increasing use of orthochromatic film stock, the ray filter is fast becoming an essential item with any equipment. By virtue of its color separating properties, beautiful cloud and landscape effects are obtainable, and a more faithful rendering of relative color values obtains in the negative. Aside from these features, its softening effects on the ultra-violet rays encountered in outside work makes it a valuable adjunct when working with strong back lighting or glaring reflection. The densities found most suitable to employ in order to avoid unnecessarily long exposures are the Wratten K1 and K2 filters. These filters can be obtained in the form of supplementary lens units, which fit over the flange of the usual camera lens. In some cases a special holder is mounted on the lens, with the separate color filter units fitting into said holder. These filters are also desirable for

filming through a fine mist or haze, which is apt to prove troublesome when no filter is used. Furthermore, there are special filters or screens now available which serve to equalize the otherwise unequal reflective powers of the foreground and background of a picture, so that a uniform exposure may be obtained for both these elements.

And the All-Important Matter of Lenses

It is perhaps well here to add a few words regarding lenses, for while lenses may be considered part and parcel of the motion picture camera, there are always additional lenses to buy for any camera when a large variety of work is to be undertaken.

The rise of the motion picture industry has brought up new problems, including a demand for lenses of great speed, since the motion picture operator cannot control the weather conditions and must usually take his pictures just as he finds them. Owing to the short focal lengths which are ordinarily demanded, the speed of f:3.5 is readily attained with fair depth of focus. This means that the light admitted to the film is almost double that of the f:4.5 lens used on the fastest types of "still" cameras. Compared to the ordinary camera lenses, the f:3.5 is five times faster.

Owing to the short focal length of these lenses, generally 2 inches, they have remarkable depth of focus even at full aperture. A greater speed than f:3.5, while attainable in some lenses and useful on certain occasions, generally shows a considerable lack of depth. The f:3.5 represents the highest practical

speed for most work, and it will be found that even f:3.5 lenses must be stopped down in good light so as to prevent over-exposures.

Speaking from first-hand experience, the author generally uses the Bausch & Lomb Series Ic f:3.5 lens, which he finds an excellent objective. In fact, persuaded by the incessant lauding of German lenses by so many cameramen, he did try a Carl Zeiss f:3.5 lens for a while, but the negatives obtained with that German objective did not show any points of superiority over the domestic lens. This generally accepted belief in German superiority in optical goods seems to be a hang-over from the pioneer days, when other nations, our own included, were trying to learn the art of making lenses. The author uses a 2-inch B. & L. lens for general work, which is the standard lens in the field and studio. The 1⅝-inch focus lens is another standard, especially in studio work where a wider angle must be taken in because the camera cannot be backed far enough away from the subject when a 2-inch lens is used. Then there is the 3-inch lens, which gives an image half again as large as when the 2-inch lens is employed. Finally, there are the 6-inch and longer focus lenses which are used in making close-ups from the same point where the scene has been taken with the usual 2-inch or the 1⅝-inch lens, and for photographing distant or inaccessible subjects outdoors.

The author has made good use of a special French lens of 55 mm. focus, which is approximately 2 inches, imported and mounted for him by Mr. Maurice H. Schoenbaum of New York City, who is a specialist in

motion picture lenses. This lens gives remarkable results when working in poor light. It is rated as an f:2.5, yet possesses considerable depth of focus when used wide open. Still another lens employed by the author is a 6-inch Dallmeyer lens of British manufacture, with a rating of f:6, which is used for making close-ups from a distance and for photographing distant objects.

Motion picture lenses may be furnished in barrels with iris diaphragms, in focusing mounts with a lever that moves the lens in and out of its mounting, or in special mountings fitted with a rack and pinion jacket. By revolving the lens hood of the B. & L. standard lens mounting the diaphragm openings are changed and a pointer operating against a scale on the hood of the lens indicates the opening used. The lever on the side pushes the lenses in or out, indicating the distance on the scale around the body of the mount.

In the rack and pinion mount we have an ideal outfit for the man who wishes to use two or more lenses. The lenses set back in a double tube, the outer one fitting the jacket by a sliding fit and the inner one rotating so as to control the diaphragm. The mountings also serve as lens hoods, and the diaphragm settings can be read off on the outer end of the tubes.

For wide-angle effects the Tessar Ic, f:4.5, 32 mm. (1¼ inches) focus can be used. This lens is useful also for fixed-focus work. It can be fitted to the focusing mount if desired. On the standard-sized film, the 3-inch B. & L. lens gives 20 deg., the 2-inch

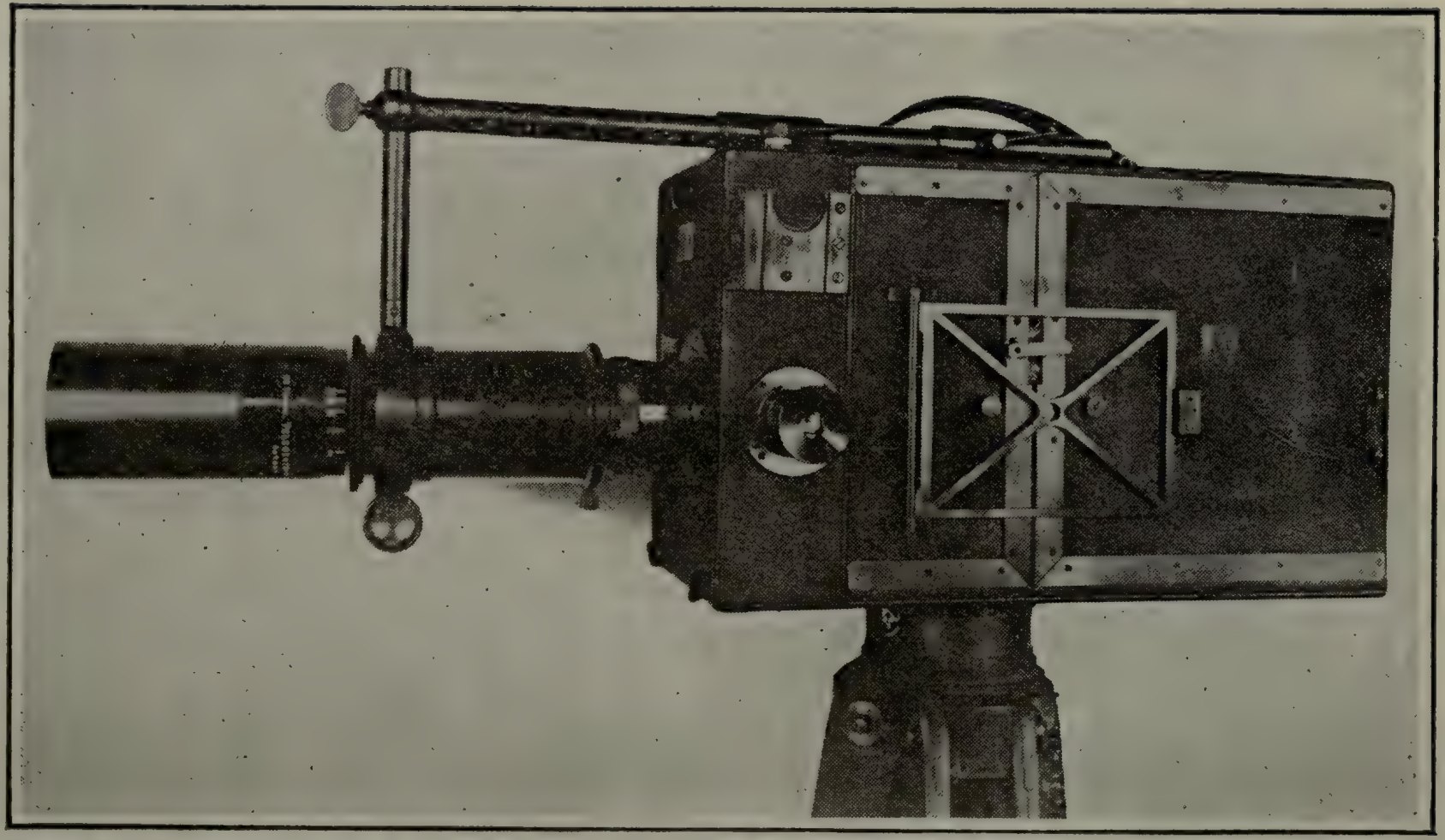
gives 29 degrees, and the 1¼-inch gives 44 degrees.

Another popular lens for motion picture work is the Kino Hypar made by the Goerz American Optical Company. The Hypar series is made in 1⅝-inch, 2-inch, 2⅜-inch, and 3-inch focus, with an effective working aperture of F:3.5. A special Hypar lens of F:3.5 with a focal length of 20 mm. or ¾-inch is also made for special work, covering a circle of ⅝-inch diameter.

The Hypar belongs to the series of unsymmetrical lenses, the lens system being composed of three single lenses only, of which two are mounted in front of the diaphragm, and one back of the diaphragm. The aperture of the diaphragm of the Hypar lenses will be found somewhat smaller than the effective aperture of the lenses, for the reason that the front combination is a positive or converging element, bringing the beam of light entering the front lens down to a smaller diameter when it enters the iris diaphragm. The second nodal point from which the focal length of a lens is to be measured, lies about ¼ inch in front of the diaphragm, which accounts for the short back focus of the Hypar in comparison with other lens of the same focal length.

Telephoto Lenses and Their Work

For telephoto work, where it is required to take pictures at a great distance away, the author does not recommend telephoto lenses of the kind employed by the still photographer, for the reason that they are too slow and give insufficient definition. He recommends any one of the several excellent domestic



An English camera provided with a Goerz telephoto lens held steadily in place by means of an extension support. Note the large direct view frame finder hinged on the side of the camera. This is English practice and is found in certain English cameras.

and foreign cinematographic lenses of 6-, 7-, 8-inch or even greater focus, working at anywhere from F:4.5 to F:6. There is the Dogmar, made by the Goerz organization, working at F:4.5, and the Celor of the same make with a speed from F:4.8 to F:5.5. A lens of 8¼-inch focus is often the best suitable for long range work, giving as it does a little over four times magnification in comparison with the regular 2-inch lens. But it is obvious that when using lenses for long-distance filming, one must not expect a microscopically sharp definition every time, because atmospheric conditions, such as a slight haze or certain light conditions invisible to the human eye, are noted by the lens and result in a noticeable lack of definition. In fact, the use of optically corrected ray screens is recommended when taking long-distance views. For photographing wild life, such as birds in their nests, the telephoto lenses will be found invaluable on account of one's ability to shoot the subjects from a distance with little loss of speed.

Of late years "soft-focus" photography has come into vogue, especially in still photography where artistic expression is desired. Motion picture photographers, wishing to emulate and even surpass the very best work the still photographer is capable of producing, have recently turned more and more to soft-focus photography with pleasing results on the screen. Soft-focus pictures possess a softness which can never be obtained when using standard lenses with their needle-sharp detail, except by some uncertain improvision such as photographing through muslin.

It was with the desire to meet the demands of

Sample strip of positive film made with soft-focus lens.

motion picture cameramen for soft-focus lenses that the Wollensak Optical Company of Rochester, N. Y., recently began to make their Verito lens in special focal lengths of 3-inch and shorter. Today a considerable number of motion picture cameramen are using Verito lenses of 2-inch and 3-inch focus, with speeds of F:4 to F:6.

The soft-focus lenses are used largely in making close-ups, where an idealistic treatment is desired. Lenses of this type render an atmospheric quality that is beautiful in the extreme, especially when accompanied by well worked out

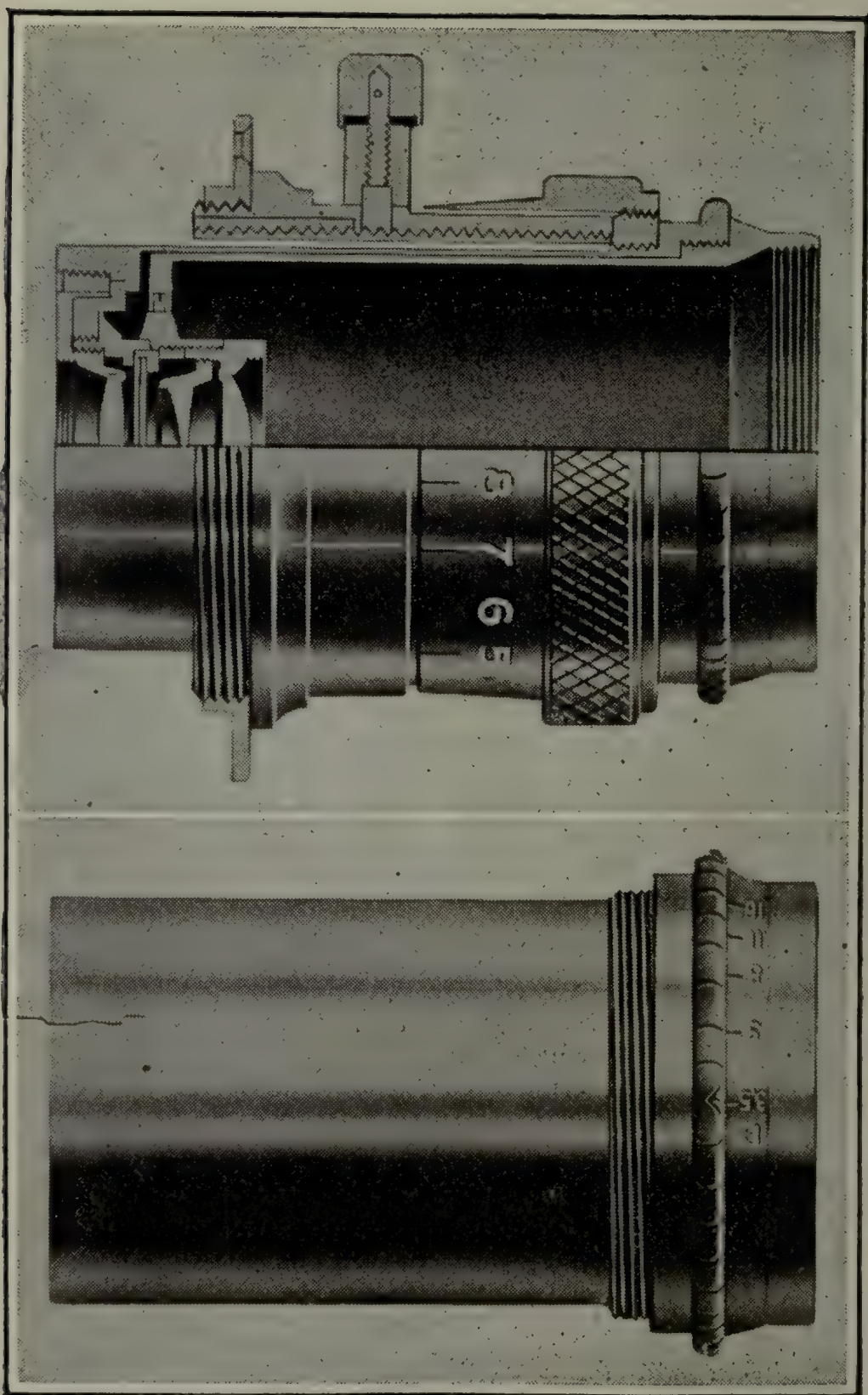
lighting effects. They are also suitable where a pictorial quality is desired in a landscape. Indeed, it is said of soft-focus photography that a tenement house may be made to possess all the charm of a French chateau! Even the most commonplace things take on a new and beautiful aspect when reproduced in soft focus.

An advantage of the Verito motion picture lenses are their convertibility. It is possible to use either the double combination or the rear lens alone, which has a focal length of about twice that of the doublet.

Aids to Focusing

The selection of a suitable focusing device for the cinematographic camera is a very important consideration. In fact, some cameramen fail to produce good pictures because they are not working with a satisfactory focusing device.

Something has already been said regarding the standard types of focusing mounts which are generally supplied with cameras. However, where careful work is to be done, it is well to give due consideration to the micrometer mounts that are special equipment. One of the most popular of these micrometer mounts is that made by the Goerz organization, which comes in two models. The Model A is a small mount to which only one lens can be fitted, while the Model B is larger and takes a series of lenses interchangeably, each lens being fitted to a separate lens tube which is screwed into the main focus barrel. Both Goerz micrometer mounts have the same design, the difference being in the diameter of the main focusing bar-



Goerz micrometer mount for lenses, which permits of extremely delicate yet positive focusing where the greatest care is called for.

rel. This main focusing barrel consists of three tubes: the indicator tube, the micrometer tube, and the barrel. The thread of the micrometer tube is of the triple thread type, having 1 mm. pitch or 24 threads to the inch. One revolution of this tube is equal to 1/8th inch. The model A mount allows three complete revolutions or 3/8th inch; the model B, on the other hand, allows five complete revolutions or 5/8th inch.

The indicator tube of either mount, which is connected with the micrometer tube, is divided into fifteen parts and each revolution is marked by cross lines on the barrel. These fifteen engraved lines do not indicate any focusing scale at all. They are simply equally spaced lines. Their purpose is to enable the operator to place his lens repeatedly at exactly the same position. Now, in case the cameraman has three lenses to be fitted in the Model B mount, and as each lens requires a different displacement for the same distance between camera and object, this method of dividing the tube in equal spaces offers a ready means of setting up a tabulation of the distances required for the various lenses.

These tables are made as follows: The camera is set up and focused at a point far away with a 2-inch lens and focused through the focusing tube of the camera. Upon turning the mount back and forth until the acme of sharpness is obtained, the reading of the indicator is noted and recorded. The same is done for a certain set of lesser distances, say 4, 6, 7, 9, 12, 15, 18 and 21 feet. The same procedure is followed when using the 3-inch and 6-inch lenses.

While all the standard makes of cameras of the better kind are provided with magnifying focusing devices as an integral part of the mechanism, there is occasionally a call for something better where the most accurate kind of work is desired. Therefore the Goerz organization has developed a new focusing microscope built along the lines of a short telescope, giving six to eight times magnification, right side up, and covering the full picture size. Its adjustable ocular carries a fine cross-wire, which lies in the plane of the picture image and serves to facilitate focusing on this plane for eyes of different strength. The focusing microscope consists of several sliding tubes which carry the objectives and the ocular. The ocular is fitted with an indicator tube which is turned to the right or left till the sharpness of the crosshairs is obtained dependent on the eye of the observer. This position can be read on the engraved tube of the ocular and the operator must bring the ocular always into this position when the microscope is used, no matter whether the object focused on is near or far.

Chapter IV.

THE OPERATION AND CARE OF THE MOTION PICTURE CAMERA

THE difference between good camera work and poor camera work is not so much a matter of possessing an excellent outfit as it is a matter of knowing how to use any outfit properly. Carelessness in little details makes for poor results, no matter how excellent the outfit employed may be. From start to finish the cameraman should always exercise the maximum care, not only in order to turn out good work, but in order not to jeopardize the subjects which he is filming; for if a film turns out poorly, all the work that went to produce the scene being filmed has been wasted.

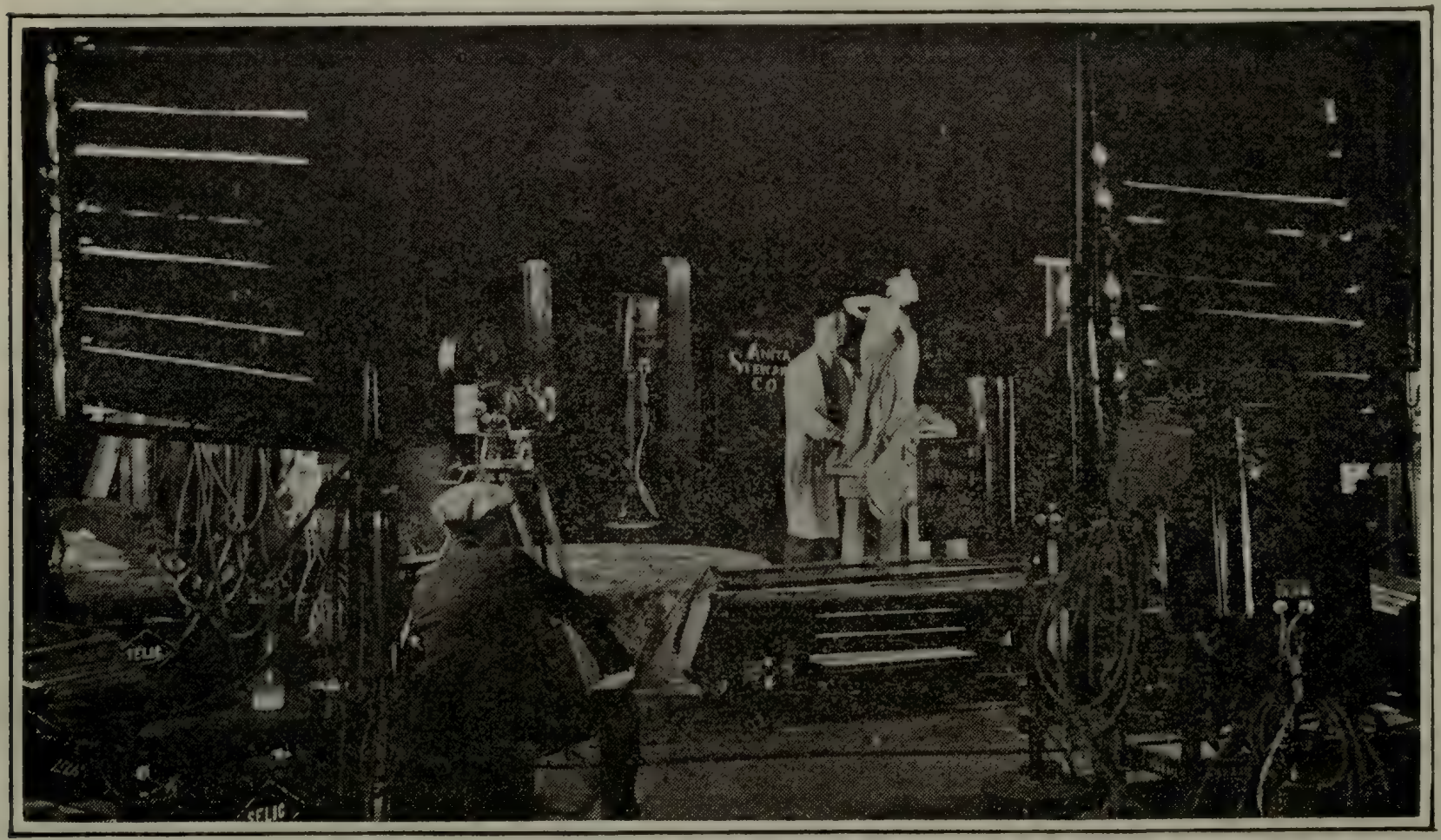
Negative Film and the Magazines

The first step in discussing camera work is to mention the negative film. This film is several times faster than the positive film on which the prints are made from the finished negative, and great care should be exercised in handling it until development in order to avoid fogging its super-sensitive emulsion. In fact, so sensitive is its emulsion that negative film ages rapidly and becomes fogged even if kept in light-tight containers. For that reason it is preferable to buy film in such quantities as will ensure its rapid consumption, except where large quantities have to

be carried in stock, such as during long voyages to distant lands where film cannot be obtained on short notice.

Film comes both perforated and unperforated. The large producing companies generally prefer to buy their film raw stock unperforated, so that they may do their own perforating. In this manner they have a definite control over the accuracy of the perforations, so they claim. For the amateur user, however, the perforated film should be used, since a perforating machine represents a heavy outlay and there is virtually nothing gained in doing one's own perforating on anything but a vast scale.

Of negative stock, there are several different makes. The negative produced by the Eastman Kodak Company is the standard in the United States and in most other countries. The author has employed Eastman to a greater extent than any other negative stock, and has found it by far the most rapid and certainly the most constant. Eastman is a safe standard for all cameramen, although there is perhaps no harm in trying the other brands now on the market. There is a Belgian negative stock, the Gevaert, which is also good, but not as fast as Eastman. This means that due allowance must be made for the difference in the speeds of the emulsions when using slower film, and some experience or tests are required to accomplish this satisfactorily. Then there is the Pathé negative, which the author has employed to good advantage. Pathé negative is about as fast as Eastman and produces excellent negatives. In normal times there is a German negative film, the Agfa, which is worth



Typical studio scene, showing the arrangement of the mercury vapor lamps used for side lighting. These lamps are mounted on wheeled stands so that they may be moved to any part of the studio floor.

trying. Since there has not been any Agfa negative on the American market for so many years, it is impossible to state at this writing just how the German product now beginning to arrive compares with others.

At any rate, negative film should be selected with care, and the few cents per hundred feet that may be saved on one brand over another should not induce the cameraman to choose a cheaper brand, unless he is certain, through long experience, that said cheaper brand will produce satisfactory results. There is generally too much at stake in filming operations to take a chance on doubtful negative.

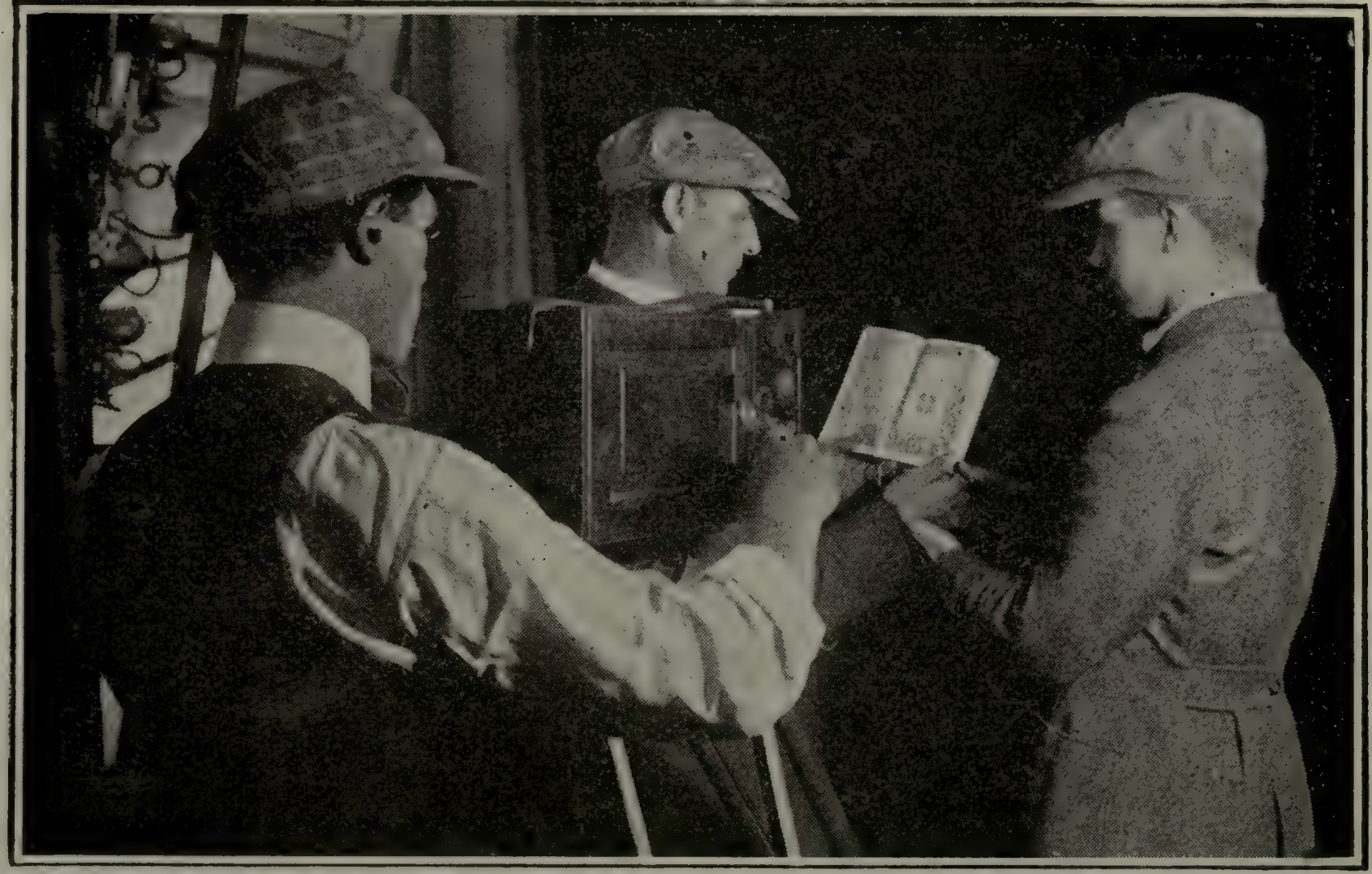
Eastman film comes in two varieties, the plain film and the X-back. The plain film is used under normal circumstances, while the X-back is used during extremely cold weather, when there is danger of static. Static, as mentioned in the previous chapter, is frictional electricity generated during the operation of a camera in extreme cold and dry weather. It makes known its presence by marking negatives with fine, tree-like or lightning-like markings which cannot be eliminated. Bad cases of static ruin a negative beyond recovery, since whatever is on the negative is certain to print on the positive and hence get on the screen. The X-back film prevents static to a great extent, being coated on its celluloid side with a certain preparation that lessens the dielectric properties of the film. This preparation, on the other hand, does not interfere with the use of the film in any way, and washes off during development. The amateur cameraman should ask for X-back negative whenever

the weather is extremely cold and dry; in fact, it is best to use it throughout the late fall, winter, and early spring, as a precaution.

Eastman film comes in 200-foot and 400-foot lengths. The cameraman who uses a camera with 200-foot magazines should make sure that he buys his film in 200-foot rather than 400-foot lengths, for otherwise he will be obliged to rewind the film into two 200-foot rolls, and this entails considerable work, not to mention the danger of fogging or marring the delicate negative. In the case of Eastman X-back, the film does not come in even 200-foot or 400-foot lengths. It comes in odd lengths, such as 179 feet, 183 feet, 189 feet, and so on. However, the cameraman can use any of these lengths if he but exercise proper care in setting the footage indicator on his camera after the film has been loaded, so that he does not run out of film in the middle of a scene towards the end of the roll.

The film being at hand, the next step is to load the camera magazines. These devices, as previously mentioned, make possible the daylight loading of the camera. But the magazines have to be loaded in the dark, to be sure, just as in the case of plate-holders; but once loaded the magazines may be placed in and taken out of the camera in broad daylight.

Different makes of cameras have different kinds of magazines, as we learned in the previous chapter. However, the author shall attempt in this chapter to make the instructions as broad as possible so that they may apply to all makes of cameras, especially if the cameraman has the special instructions that go with what-



Making a close-up of a book. In all such close-up work it is absolutely necessary to focus through the peep-hole of the camera, since the depth of focus is so slight that the cameraman cannot depend on the usual focusing scale.

ever particular make of camera he happens to be using.

The magazines should always be kept in the best condition possible. In some cases the magazines are provided with velvet or felt light-traps or pads, which are apt to accumulate dust in the course of protracted use. It is well to examine these light-traps at frequent intervals, and to brush them off with a soft brush. Small bits of film sometimes become imbedded in the hairy material, and if they are not brushed off they tend to scratch the negative. If the pads show signs of wear, and there is danger of their leaking light, it is best to discard them and use new pads. In some makes of cameras, the Universal in particular, the pads may be readily renewed at frequent intervals. Other cameras, such as the Bell & Howell, Wilart and others, have special automatic light traps that are only closed while the magazine is being handled, but open wide when the camera case is closed and the camera is ready for action. Obviously, such magazines require the minimum of attention, having no wear and tear to speak of.

The magazines should be thoroughly brushed out to make sure that they contain no dust to mark the film. If the magazines have spindles, these should be tested to see that they turn freely. The loading of the magazines should be done in a dark room, if possible, with only the aid of a ruby light. The emulsion is so sensitive that even ruby light is apt to fog it if the light is too strong. Whenever possible the cameraman should load the magazines in pitch blackness, depending on his sense of touch rather than sight.

Some magazines take the negative roll as it is, wooden spool and all. These magazines have a shaft that holds the usual wooden spool that comes with the roll of film, and rewinding is therefore unnecessary. This is an advantage, to be sure; for every additional handling of the film entails that much more risk of fogging.

Some camera magazines require the rewinding of the film on special metal spools, and this work should be done in a safe dark room with as little red light as may be necessary. Once the negative roll is in the magazine, care should be exercised to make certain that the film is firmly in place and protrudes through the slot. The end of the film is turned back and placed in the slot, so as to form a loop. This prevents the end of the film from being accidentally rolled back into the magazine.

Now a darkroom is not absolutely necessary for the loading of magazines. The author has occasionally resorted to a heavy blanket when loading magazines at night, thus avoiding the trouble of having to set up a safe darkroom. Again, the cameraman can make use of a changing bag, which is a contraption of light-proof fabric provided with two sleeves into which the cameraman can thrust his hands and open film cans and magazines inside the bag without danger of fogging the film, even in bright sunlight. A changing bag is a very necessary part of the cameraman's equipment, for it enables him to load and unload magazines in the field, and to make any necessary adjustments in a magazine that develops trouble during filming operations.

Carrying cases for the camera and its accessories. The careful cameraman always uses carrying cases for his equipment, not only because it saves the equipment from hard knocks, but because it keeps all of the outfit together.

Preparing for the Day's Work

The camera should be kept in first-class running order. It should be frequently examined, cleaned and oiled where necessary. It is a delicate piece of mechanism and requires all the care that any automobile, sewing machine or other elaborate mechanism requires. When preparing for a day's work the cameraman will do well to go over his camera, threading it with a short length of waste film which should always be available for such tests and adjustments. The instructions that come with the various makes of camera tell just where oil should be applied, in order that no oil may get on the film-bearing members and thus ruin the negative.

After examining and oiling the camera, the cameraman should get his outfit together and ready for the day's work. It is a fact that unless care and thought are exercised, the cameraman gets out to his work with part of his equipment missing. Thus he may be ready to film his subject and discover that he has not brought along the tripod handles, without which he is more or less helpless. Again, he may even forget the camera crank, unless it is a camera that has the camera crank hinged to the mechanism so that it cannot be removed. In this respect the author cannot help but praise the Universal camera, because the finder, crank handle, ground film and so on are placed inside the camera case.

At any rate, the cameraman should make sure that he has all the necessary equipment together before he starts out. While it is true that a carrying case adds

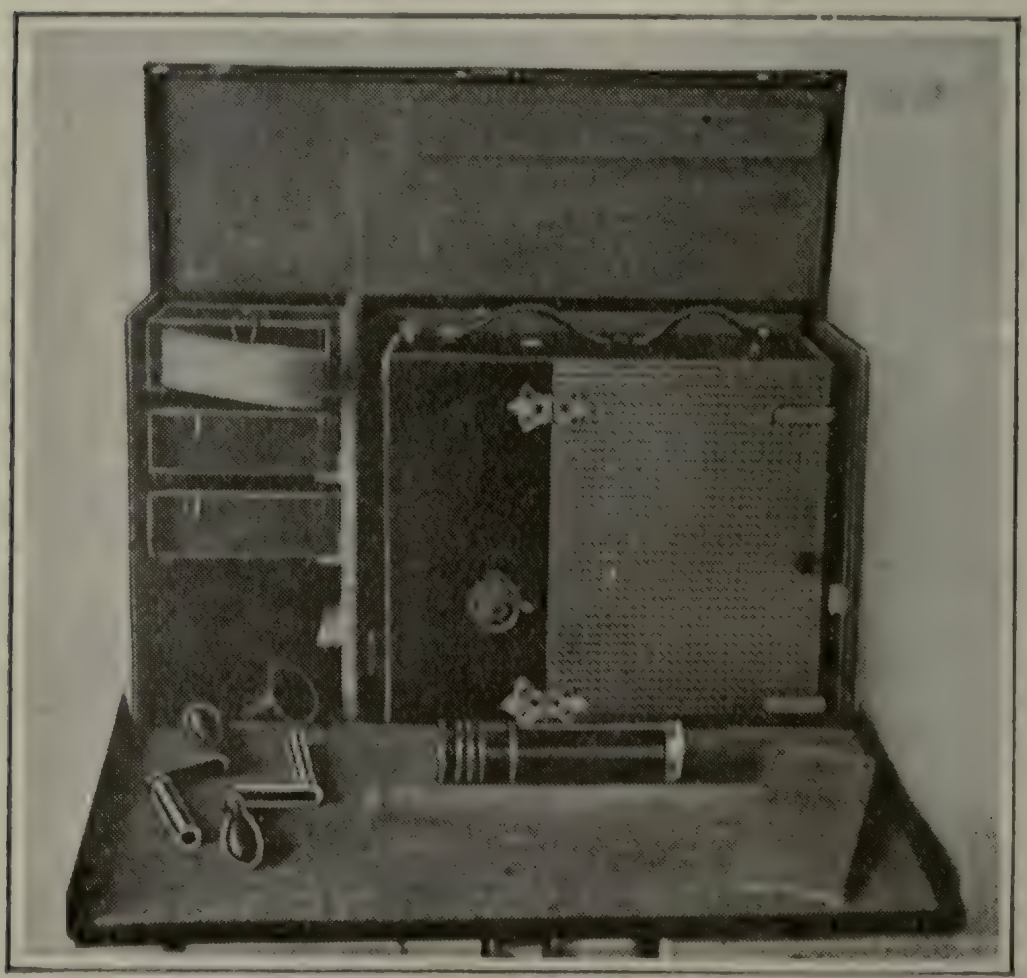
a great deal to the weight of the outfit, it serves to save the camera from bad knocks and also keeps the whole outfit together. Most cameras can be supplied with suitable carrying cases which take the camera, extra magazines, extra lenses, crank handles, accessories and so on, in one or more cases. If the cameraman is not using cases, he had best make up a list of the things required on any job, and before starting out on the day's work check off this list to make sure that everything is being carried along.

One word of caution: If the camera is of the Universal type or any make that takes the film on the original film spool, it is well always to have a supply of wooden spools on hand. The author was filming a social film not so long ago and experienced trouble. The bottom magazine did not take up, with the result that the film piled up in the camera case and became torn by the sprockets. An examination of the bottom magazine and take-up showed that the mechanism was functioning properly. Yet three times this same difficulty developed, each time causing much embarrassment since twenty or more persons were wondering why each effort to film such a simple scene should prove futile. Finally, the author discovered the trouble. The wooden spool used in the bottom magazine was worn out; that is to say, the hole through its center had been scraped out by the action of the magazine spindle, and the tiny prongs on the spindle were not engaging with the wooden sides of the enlarged hole. So the spindle was turning, but the wooden spool was not; hence the film was not being taken up. So this word of caution: always carry

extra wooden spools and make sure that the take-up spool used firmly engages with the spindle.

Threading the Camera

Different cameras are threaded in different ways, but the principle is always the same. The magazines



The author's Universal camera and accessories in the carrying case. Note the extra magazines at left, and cranks, 6-inch lens and exposure meter in foreground.

are placed in position, with the empty magazine in the take-up position and the loaded magazine at the top or feeding position. Several feet of negative, de-

pending on the make of camera, is pulled out of the loaded magazine for threading purposes. The negative is threaded through the various sprockets and idlers, with ample loops left at top and bottom. The loops should be of such a size that they do not flap against the sides of the camera, yet are of sufficient length to allow free movement. The film should be placed in the gate with care, so that it is not pinched when the gate is closed. The lower or take-up magazine is then opened and the end of the film is folded back about one-quarter of an inch to make a crease transversely across the film, this little bend being used to fit into the slot in the film spool. Then, turning the spool once or twice, the film is certain to make a firm connection with the spool. Some spools have a clip arrangement for receiving the end of the film, in which case the plain straight end is inserted. With everything in place, the crank handle is engaged with the cranking shaft and given two or three turns while the camera case is left open, in order to make certain that the film is properly threaded and everything is working satisfactorily. Then the camera case is closed and the camera is ready for action.

The footage indicator should always be set with regard to the film in the magazine. Thus if the film is of the standard length, the camera footage indicator can be set at 5 feet, which represents the amount, more or less, used in threading. Thus if the film is 400 feet long, and the footage indicator records up to 400 feet, the indicator needle is set at 5 feet and everything is in readiness. If, on the other hand, the film is 186 feet long, the indicator is placed at

5 and the cameraman must remember that the film will run out at 186 feet. Better still, the indicator can be placed at 219, which makes allowance for the 5 feet of threading, and the cameraman then need not worry about calculations, knowing that the film will run out when the indicator swings around to 400 feet.

Some footage dials have two pointers or indicators, one indicating the footage passed through the camera, and the other remaining in whatever position it is placed. The object of the second pointer is to indicate the beginning of a scene, so that a footage reading can be had for the scene as well as for the total. In the case of the Universal camera the dial itself revolves to indicate the total footage opposite a mark on the stationary ring that frames the indicator dial, while a stationary pointer can be set to zero before each scene. In this manner the total footage is indicated as well as the footage for the last scene. Each time, of course, the stationary indicator must be moved up to zero on the dial.

The setting of the footage indicator is important, for there is nothing more annoying than to run out of film in the middle of an important scene. If there is any doubt about the length of negative being placed in a magazine, the footage indicator better be set with plenty of film to spare, rather than too short.

Setting Up Preparatory to Shooting

Arriving on the scene of the filming operations, the motion picture apparatus should be prepared for action. This is known as setting up. The cameraman should select the best possible position for his camera,

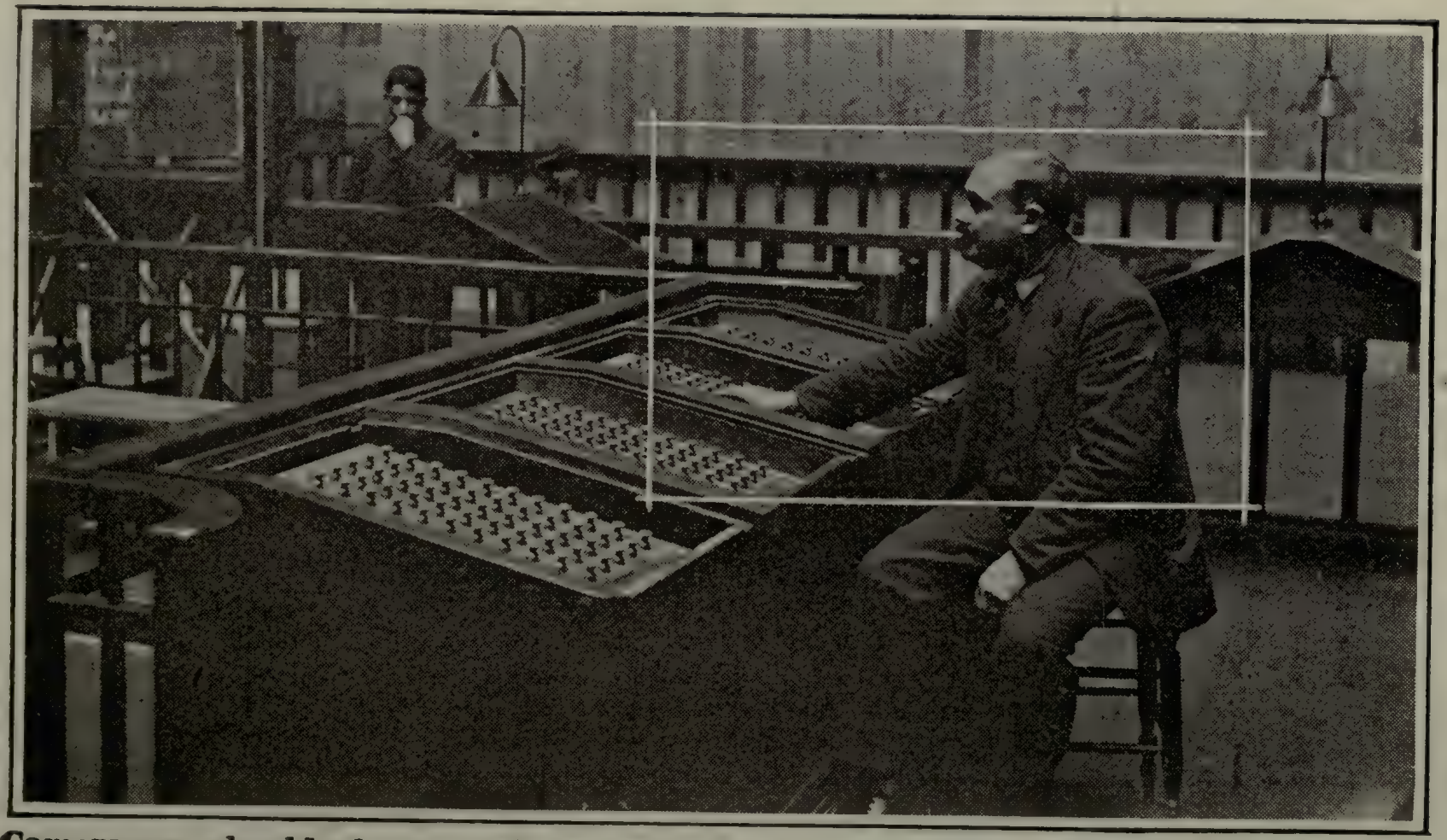
being guided by the light, subject, action and other considerations. The tripod should be opened up and set on the ground, with the legs at the required height. Just how high to make the tripod is a matter which circumstances and experience dictate. The author finds that the average tripod is of about the proper height for the general run of subjects, without extending the legs. However, if children or other subjects close to the ground are to be filmed, the tripod should be spread out so that it will be lower; and if close-ups of adults are to be made, the tripod legs should be extended and the camera placed rather high, on a level with the neck of the subjects. If the camera is placed too low in the filming of adults, the adults appear unduly tall and consequently unnatural on the screen.

It is well always to have the tripod legs spread out to an angle of at least 60 degrees with relation to the horizontal. If the legs are not spread out to any extent, the camera is not afforded a solid foundation on which to operate. It is better to pay out some of the extension legs and to have the legs spread apart. In places where the ground or other foundation for the tripod is irregular, some ingenuity is required to set the tripod legs. In such cases the three legs need not be extended to a common length, but it is well to make sure that each tripod tip makes a solid contact with the ground on which it stands. The usual tripod tips are of sharpened steel, so that they will not slip. However, when working on smooth pavements there is some danger of slippage. Needless to say, if the tripod slips during

In filming subjects that are of an explanatory nature, the cameraman should seek to get his subject as large as possible. Why have all the meaningless area in this particular scene? The small square indicated contains the entire picture.

filming, the scene may be ruined because of the sudden jump and shifting of the picture. When working on smooth surfaces, such as sidewalks, the tripod tips should be placed in cracks whenever possible, or even in corners. When working on very smooth surfaces, such as tiled floors, it is sometimes impossible to obtain a secure footing, so to speak, for the camera, in which event the cameraman should obtain a large square of wood on which to place his tripod. In many studios the cameramen make use of triangular wooden frames for holding the tripod. Again, some cameramen use straps or wires between the legs of their tripod so that the legs will not slip away from each other.

After the tripod has been set up with the head perfectly level and straight, the cameraman should apply his full weight on it to make sure that the tripod is steady. The camera is then placed on the tripod stand and screwed tightly in place. The knack of screwing the camera in place is one to be acquired, especially where the cameraman must work fast, such as in news work. The author generally settles this phase of the multitudinous operations of filming, by placing his Universal camera on the stand and, holding it in one hand, by tilting it over to one side while pushing up the wing nut of the tripod screw with the other hand. The screw hole at the bottom of the camera can then be seen in bright light, as well as the relative position of the screw protruding up through the tripod stand. The camera is then shifted slightly one way or the other, until the screw hole comes in position over the screw,



Cameramen should always seek to avoid the non-essentials. In this scene, showing a push-button keyboard, it is only necessary to show the small section indicated. In fact, it often makes a scene more interesting if all the apparatus is not shown, especially where it would be repetition.

the latter being then driven home. In mounting the camera, the worm box of the tripod should be at the rear of the camera. The position of the legs with relation to the camera is of little importance, but the author generally prefers to have one leg straight ahead of the camera, and the remaining two on either side of him.

Determining the Exact Focus

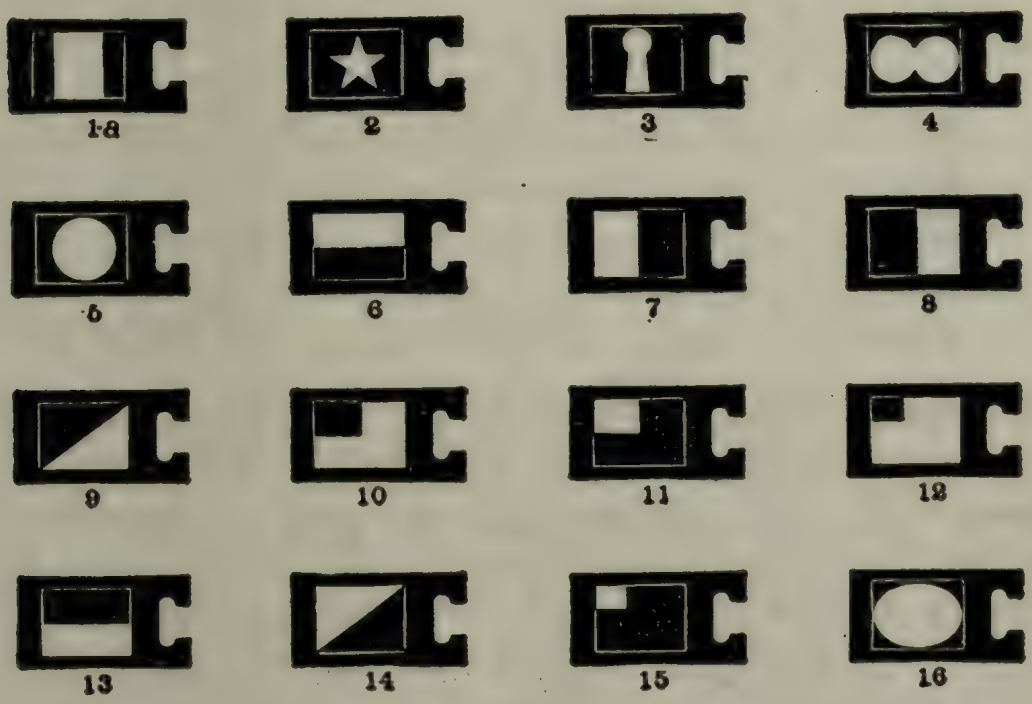
Focus is always an important step in making photographs of any kind, for improper focus makes all the difference between a sharp photograph and a blurred one. There are two ways of focusing with the general run of cameras, namely, the guess-focus and the exact-focus. In the case of the guess-focus, the lens, which is generally provided with a distance scale, is adjusted so that the scale indicates the approximate number of feet that the subject is from the lens. Because of the small focal length of the usual motion picture lens, there is little danger of blurred images when using the guess-focus method, although for extremely accurate work it pays to take the time and trouble of focusing by means of the peep hole or focusing door. Some cameramen carry long tape measures on their tripods, and use them in scaling off distances up to 25 feet in order to set their lenses with great precision. But with a little practice one soon becomes competent to estimate distances within a fair degree of accuracy.

The precise method of focusing is to focus on the negative film itself or on a piece of ground film or ground glass. Different cameras have different

methods of focusing, as we have learned in the previous chapter. Some cameras are provided with matched finder and photographing lenses, simplifying this process. With the less elaborate cameras, however, focusing may be accomplished right on the yellow negative film by looking through the peep hole or focusing door. The image is then seen just as it will actually register on the film, upside down, and sufficiently magnified by the magnifying lens of the focusing arrangement so as to facilitate sharp focusing. If, upon looking through the peep hole or focusing door, the image does not show on the film, the crank handle is given a slight turn so as to turn the shutter, thus bringing the light from the lens to the film. If the image is too dark, the lens should be opened by turning the iris diaphragm control. It is generally best to focus with the lens wide open, thus obtaining the maximum illumination.

The yellow film is, of course, a poor medium on which to focus. When the light is rather dull it is often difficult to see the image with sufficient clearness to make an accurate adjustment. Therefore, where careful work is being undertaken, it is generally advisable to insert a piece of ground film in the film gate. Ground film is nothing more than a piece of standard film or a piece of somewhat heavier celluloid, which has been treated in such a way as to give it a frosted or translucent finish on one surface. The author has made ground film from ordinary film by first removing the emulsion with warm water, and then rubbing the plain celluloid with steel wool and even with scouring powder or pumice. The

insertion of the ground glass or film naturally means, in many instances, that the camera must be opened, thus causing the loss of whatever film happens to be threaded and outside the magazines. The regular film is removed from the gate and the ground glass or ground film put in its place, after which the cameraman focuses carefully on same. The ground



Masks used with the Universal camera and which are typical of those employed with most cameras for various effects.

or dull side of the glass or film should face towards the lens. The focusing being accomplished, the ground glass or film is removed, the negative put back in the film gate, and the camera closed. The crank is given several turns in order to make sure that the light-struck film has been wound into the take-up magazine and fresh film is in position for recording the scene.

Speaking of the depth of focus of the usual motion picture lens, it may be of value to refer to the accompanying table, which indicates that if a lens is focused on objects at the distances indicated, everything is supposed to be sharp from one-half that distance to infinity. This is known as the hyperfocal distance, and applies to the usual 2-inch lens:

F:1.9	70 feet
F:3.5	40 feet
F:4.5	30 feet
F:5.6	24 feet
F:6.3	22 feet
F:8	18 feet
F:16	10 feet

The focus being determined for the scene, the next step is the exposure. The amount of exposure is, of course, regulated by the lens opening or diaphragm reading. It is impossible to give any general rule governing the correct exposure. Experience is the best teacher. A beginner should make a few tests under different conditions of illumination, so that he can judge by comparison. The changeable iris of the human eye makes this organ very unreliable in judging different degrees of illumination. A source of light which appears to be one-half as bright as another is apt to be only one-quarter or even less. For this reason, the beginner is liable to overexpose in good illumination and underexpose in poor illumination. Fortunately, there is considerable latitude in motion picture negative, so that a little variation from the correct exposure will not spoil the picture.

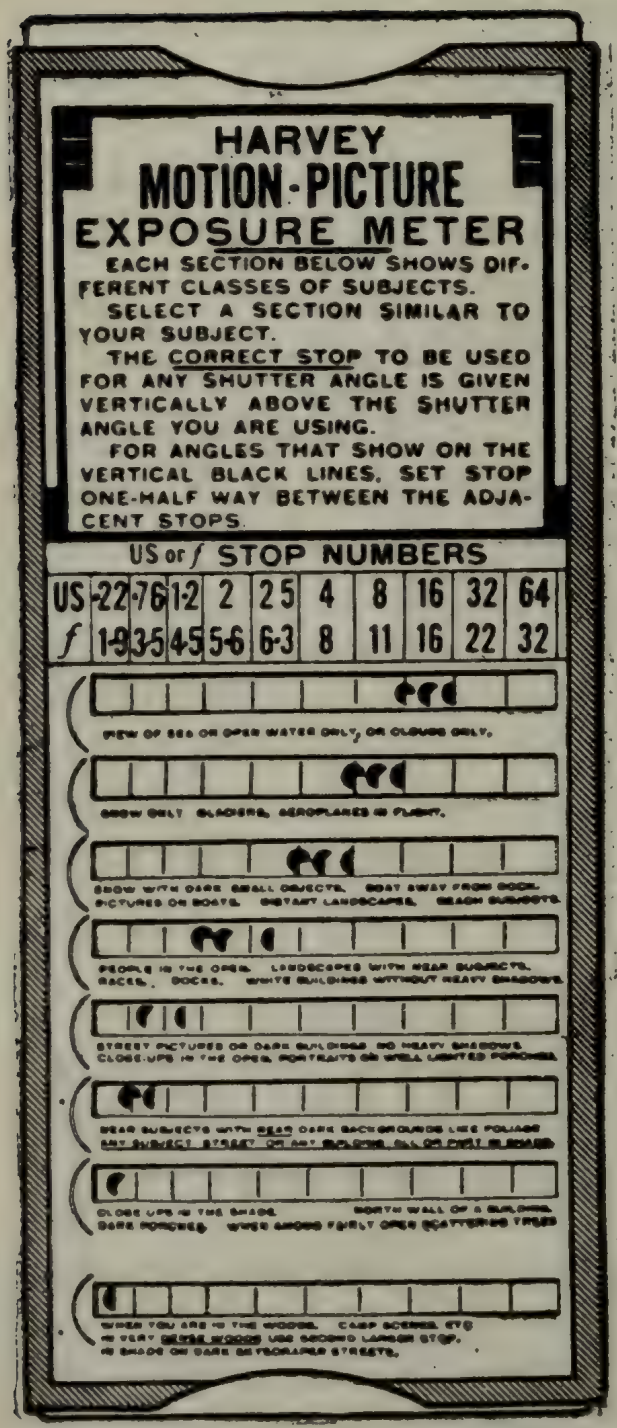
In general, it is better to overexpose than to underexpose.

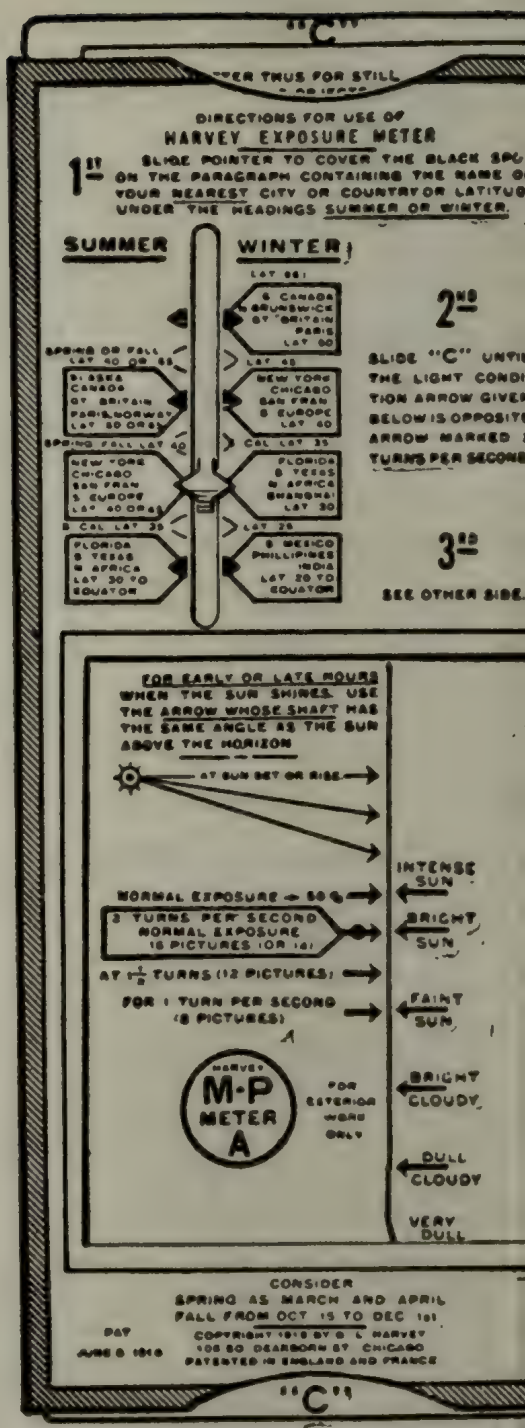
There is another factor in motion picture exposure, aside from the diaphragm opening, and that is the shutter. The shutter, as we have already learned, is a revolving affair with an adjustable degree of opening. The opening in the shutter is usually adjusted to suit the speed of the moving object. For an object in slow motion the shutter may be left wide open, while for rapid motion it is better to set it at one-quarter open. Three-eighths open is a good working average. Any movement which produces a blurred picture with the shutter set at one-quarter open (one-sixty-fourth of a second) must necessarily be sufficiently rapid to appear blurred to the eye. For this reason it is seldom necessary in ordinary work to close the shutter more than one-quarter.

Obtaining the Proper Exposure

Fortunately, there are several exposure meters which may be used by the amateur in determining the correct exposure for any subject withou guesswork and without months and even years of experience. It is true that after considerable experience one becomes quite competent to guess at the exposure required for any given light and subject, but that requires time and thousands of feet of film taken under all kinds of conditions.

There is no handier form of motion picture exposure meter than the Harvey meter, which shows the shutter setting or angle of opening instead of fractions of a second as in the meters not intended





Front and back views of the Harvey exposure meter. Th meter gives the correct lens aperture for all classes of outdo subjects and lighting.

primarily for motion picture work, and which gives automatically the proper stop to be used for any lens. No calculations whatever are required. However, the Harvey Exposure Meter, like all devices of this general character, is only intended for outdoor exposures, and when it comes to interiors with artificial light, the cameraman must fall back on tests and experience.

The Harvey Exposure Meter is shown in the two accompanying illustrations, which depict its two faces. It is made of celluloid, and has two sliding members contained within the outer case or envelope. One slide takes care of the time of the year and locality, while the other regulates the strength of the light. Thus if pictures are being taken in New York, during the summer, the first slide is moved so that its indicator points to New York in the summer column. The second slide is then moved up or down until the condition of the light, whether it is intense sun, bright sun, faint sun, bright cloudy, dull cloudy or very dull cloudy, appears opposite the cranking speed. Two turns per second is the normal exposure or cranking speed. Then the exposure meter is turned over, and on the opposite side appear the various classifications of subjects. There are "View of sea or open water only, or clouds only; snow only, glaciers, airplanes in flight; snow with dark, small objects, boat away from dock, pictures on boats, distant landscapes, beach subjects; people in open, landscapes with near subjects, races, docks, white buildings without heavy shadows," etc., all as indicated in one of the illustrations. By determining the classification of the

subject to be filmed, one finds immediately the shutter settings for the different diaphragm openings, as shown.

When cranking at the normal speed, two turns per second, which exposes sixteen pictures per second, the shutter angles shown below give the exposures indicated in seconds.

Shutter 1/2 open = 180 deg. = 1/32 second
Shutter 3/8 open = 135 deg. = 1/48 second
Shutter 1/4 open = 90 deg. = 1/64 second

Cranking at 1½ turns per second:

1/2 open = 1/24 second
3/8 open = 1/36 second
1/4 open = 1/48 second

Cranking at 1 turn per second, or 8 pictures per second, often used for still subjects:

1/2 open = 1/16 second
3/8 open = 1/24 second
1/4 open = 1/32 second

These figures are rather complex, but it is not necessary to remember them when using the Harvey Exposure Meter.

If the sun is directly behind the cameraman's back, he will obtain what is known as flat lighting, as the shadows will be cast straight behind the subject. It is better with any camera to expose with the light coming at an angle of 45 deg. on the subject—more as though it came over either hand when extended from the cameraman; the shadows will then be

clearly seen and the objects will then stand out in greater relief. Portraits are best when the subject is in the shade or on cloudy days. In fact, some of the best films are made when the light is diffused, such as in the shade or on bright cloudy days. However, whether to use intense shadows or diffused lighting is a matter to be determined according to the subject filmed.

Highly artistic effects are obtained by photographing against the sun, securing what is known as back lighting. In this case the camera lens should be provided with a lens hood, so that the sun light does not strike the glass of the lens, causing halation. Indeed, a hood on the lens is good practice at all times for any camera. In photographing against the source of light, it is necessary to use the next larger stop than the meter calls for. Sometimes a white sheet or metal reflector must be used in order to illuminate the face of the subject by throwing back some of the sun light.

Clouds and distant landscapes, especially the Grand Canyon, snow pictures, yellow or red and most subjects photograph best when a color screen or ray filter is used. A 2- or 3-times filter is best for outdoor work. When using such filters, due allowance must be made for the cutting down of the actinic light. Thus with a 2-times filter, the next larger stop should be used, with the 3-times use 1½ larger stop, with 4-times filter use second larger stop, and with 5-times filter use 2¼ larger stop.

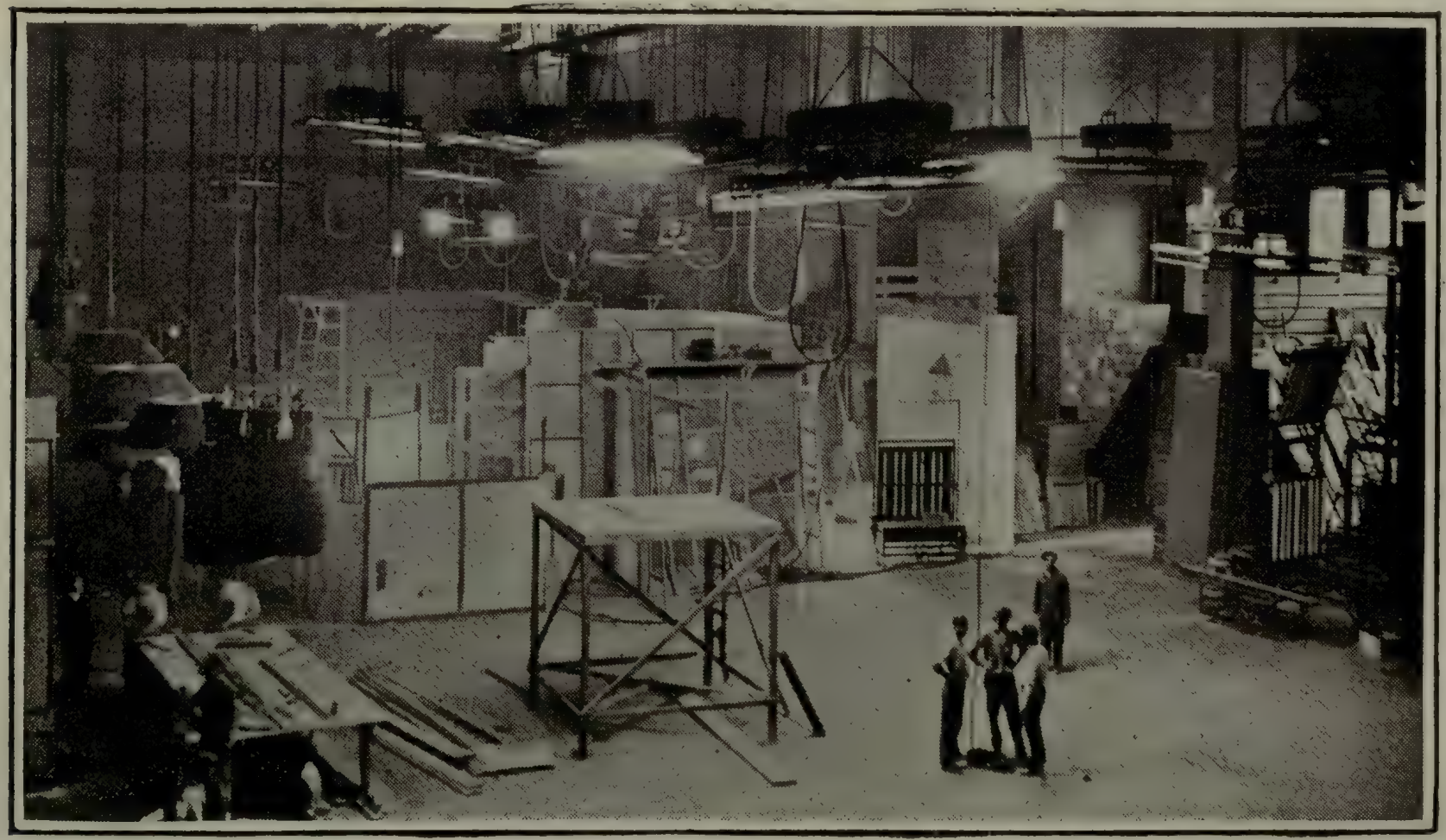
The Harvey Exposure Meter for motion picture cameras only should be part and parcel of the ama-

teur cinematographer's kit. It eliminates all guesswork and may be the means of saving much film footage in the long run. There are other exposure meters, true, but these are generally designed for still photography only, and their application to motion pictures calls for considerable calculations and allowances, therefore complicating their operation. At best, they are only improvisions when considered from the motion picture standpoint.

The Gentle Art of Even Cranking

If the exposure of motion pictures depends on the diaphragm opening and the shutter setting, it also depends on even cranking. In fact, one of the preliminaries to successful filming is to gain proficiency in cranking the camera. The beginner will do well to put waste film or "dummy" film in his camera and try cranking it. Some cameras are provided with a nice mechanism that is almost automatic in so far as the smoothness of cranking is concerned. That is to say, the mechanism is so nicely balanced and provided with flywheel momentum that the cranking is bound to be smooth. Others grind somewhat hard, and the operator must supply the even cranking himself.

The proper way to crank is to have the elbow remain stationary and on a line with the center of the crank, while the forearm and hand turn about with the handle. The "piston rod" manner of cranking, in which the cameraman stands at the rear of the camera (we are now speaking of cameras with crank on the side) and turns the crank with a



Typical studio scene, showing the overhead mercury vapor lighting units which are mounted on trolleys so that they can be moved over any part of the studio floor. These lamps are employed in connection with floor stands for lighting effects.

reciprocating movement of the entire arm, cannot be condemned too strongly. Uniform movement is more essential than the exact number of revolutions per second. Each revolution of the crank produces eight pictures. The normal speed is two revolutions per second, or 120 revolutions per minute. With a little practice anyone can readily acquire the proper speed within small variations.

In shooting a scene it is good practice to start cranking before the actual scene begins, just so as to get the cranking up to speed and to make sure that unexposed film is in position for recording the action. Two or three turns will serve in this connection. It is understood that the cameraman has carefully aimed or set his camera before beginning the filming operation, making sure that it will take in all the desired action.

Settling the Field of Action

This matter of aiming the camera, so to speak, is worthy of considerable thought if the best pictures are desired. In the case of children or other subjects that are apt to run around a good deal and even get beyond the range of the camera at unexpected moments, the cameraman is obliged to use a larger field of action. That is to say, he must place his camera some distance away from the subject, in order to provide a larger stage for his subjects; otherwise, he would have trouble in keeping his subjects within range if they should move one way or another. Where there is plenty of action of an uncertain kind, such as athletics, animal studies and so on, it is well to

The camera only records what comes within its narrow field of vision. Here, for instance, is a model indicating our declining petroleum in a calibrated barrel. The young man who is pulling down the dark slide is out of the camera's range and does not show in the final film.

have a large stage, otherwise the cameraman may find to his keen disappointment that part of the action has been out of bounds and therefore cut off.

The author, in much of his careful filming operations for the leading motion picture "magazines," has generally rehearsed each scene while looking through the finder, in order to make sure that all the action would come within the field of the camera. Of course, the close-up, or small field of action, is always the most desirable form, but the field is then so limited that the subject is apt to go out of bounds without realizing it. It is very difficult to keep within a space of five feet or less in width. By rehearsing a scene this can be avoided, since the subject then knows how much space is available for the action—the boundaries of the stage, in other words.

In making an athletic picture the author ran across a case in point. He did not allow for sufficient overhead space, desiring a close-up of his subjects. So, when the film came to be developed and printed, he discovered to his keen disappointment—and loss—that each time one of the athletes threw his companion over his back, said companion went out of the picture. If that scene had been rehearsed while the cameraman viewed it through the finder, or even the peephole for the sake of greater accuracy, this failure would have been noted and the camera moved far enough back to allow for more "ceiling," if we may borrow a good aeronautical term.

Of course, the tripod head, being equipped with the tilt and panoramic movements, may be used in shifting the field of action and following any subject

in movement. As a rule, however, the use of these movements is not to be encouraged, except for taking relatively slow-moving subjects and panoramic views of still subjects. It is not the easiest thing in the world to follow some rapidly moving object with the usual motion picture camera. The tilting and panoramic movements have to be cranked while the camera is being cranked, and these dual functions are often confusing when executed at the same time.

In the case of a panoramic or a tilting scene, it is well to rehearse the action if possible before actual shooting. Thus if some still or moving object is to be filmed, the camera can be turned or tilted while looking through the finder, in order to make sure that the desired range will be obtained.

Perhaps these precautions are too fussy—*perhaps;* but film costs money; subjects cost money in many cases; and failures might as well be avoided whenever possible. In cases wherein the subjects are news, wild-life or other features that must be photographed on the spur of the moment, without control of any kind over them, then the panoramic and tilting movements can be brought into play without preparation. The only word of advice, in that case, is to have the head of the tripod perfectly level, so that the tilt or panoram will be straight in its entirety.

In making a panoramic view with the motion picture camera it is good practice to have an assistant turn the crank, so as to ensure smoothness. In this manner the cameraman can turn the camera crank at the usual speed for the proper exposures, while the assistant, at his command, starts the panoramic

movement, goes at any speed desired, and stops when so told.

The end of each scene should be indicated on the film by means of the film punching or clipping device. Practically all the better makes of cameras have a device that either punches a hole in the film, or clips a small piece out of the edge. Such marks assist the laboratory hands in determining where scenes start and end.

The Adjustable Aperture

The aperture of most motion picture cameras may be set to any position to correspond to films out of register with the standards. It is also convenient for title work. The usual position for the picture on the film is on a line halfway between the perforations. By some simple adjustment the mechanism of most cameras may be shifted so as to change the relative positions of the picture and perforations.

Practically all cameras are provided with a trick movement or single-picture movement. When the crank is engaged with that movement, each turn only exposes one frame. All manner of trick pictures and animated cartoon films may be made with this movement, as described elsewhere.

In the matter of lenses, much was said in the last chapter. The cameraman should choose whatever lens he requires for a given scene, if he has a variety of lenses. It is true that the standard 2-inch lens can be used for practically the entire run of regular work, but it is an advantage to have other lenses, such as a 1⅝th-inch, a 3-inch and a 6-inch.

The 1⅝-inch lens comes in very nicely for work in confined quarters, where the camera cannot be backed up far enough to cover the desired field of action with the usual 2-inch lens. The 3-inch lens can be used where a larger image than that produced by the 2-inch lens is desired at the same distance, and the 6-inch lens is used for the same purpose, producing an image three times as large as the 2-inch lens at the same distance. It is employed in making close-ups from the same point as the one used in making the long shots with the 2-inch lens Thus the camera does not have to be shifted, and perfect continuity is secured in going from the long shot to close-ups and back to long shots. The amateur cinematographer will also find the 6-inch lens of great value in filming wild life, children, news events, and so on.

The Use of Masks and Vignettes

For straight work, the camera is used just as it is, registering sixteen rectangular pictures or frames to the running foot of film. If the shape of the pictures or frames is to be changed, then a mask is employed. Various shaped masks can be obtained with all the better makes of cameras. These masks come in such shapes as a circle, an oval, a keyhole, a binocular effect, star, an upright oblong and so on, as well as in matched pairs that permit of trick effects. These masks are inserted in the aperture plate of the camera in such a manner that the recorded image takes the form of the mask opening.

The simplest trick effects are produced by means

of matched masks. One mask is first inserted in the camera, and the scene exposed in that portion of each frame that is left open by the mask. The turns are counted, except if the camera is provided with a Veeder counter. Then the first mask is removed and the companion mask inserted, after which the subject

Double exposure effect made with matched masks. This is a simple double exposure method which can be made with almost any camera.

of the second exposure, which is to fill the section of each frame left unexposed in the first shooting, is carefully focused to fill said space. The film is now cranked backward or rewound into the top magazine, with the lens covered. When the original position of the film is attained, either by counting

the turns or by the Veeder counter indication, the second exposure may be made on the same length of film, so as to fill the remaining or unexposed section of each frame.

The film can be divided into halves by means of matched masks, and two bits of action recorded in this manner for simultaneous appearance on the screen. Vision effects may be obtained by companion masks. However, these effects are largely out of the range of amateur work, and for this reason the author has preferred not to go deeply into this subject. Suffice it to say that these trick effects can be mastered by the amateur for himself, after securing a good working knowledge of the camera, and the author feels that all these advanced forms of camera work are so well covered in Carl Gregory's *Condensed Course in Motion Picture Photography* that it would be but unnecessary duplication to cover the same subject here.

In making standard sized negatives for reduction to the Safety Standard or Pathescope size, it is best to avoid using the usual masks for obtaining fancy shapes. In the reduction printing it often happens that the images are somewhat cropped; that is to say, the entire frame is not taken in by the printing machine. In which case, it goes without saying, special shapes like circles, ovals, keyholes and so on are apt to be chopped off at the ends or corners with unfortunate screen results. Where reduction printing is contemplated, it is safer to stick to plain photography.

The various vignetting and double-exposure attach-

ments were described at some length in the past chapter. Motion picture photography of today has reached the stage where it is necessary for the professional cameraman to have on hand a number of different dissolve devices with which to add charm and unusual touches to his work, but these hardly come within the province of the amateur cinematographer.

The best known and most commonly used of all these attachments is the round closing dissolver for circling in and out. It is shaped like a large iris diaphragm, but its blades come to a perfect close in the center. This attachment is mounted upon an extension tube and sliding base. The extension tube is used to move the dissolver toward or away from the lens, thus having control over the sharpness or diffusion when circling in or out. It is also used for vignetting either the head or bust pictures of close-ups. When the cameraman is called upon to isolate the expression of a certain actor who is not in the center of the picture, and when, for some reason, the camera cannot be shifted, the sliding base is absolutely essential for the purpose of shifting the center of the iris to the desired position. In this case the extension of the extension tube is shortened so that the shutter clears the size of the picture; or when the cameraman desires to make about five vignetted close-ups, four to be near the edges and one in the center, for the purpose of introducing the actors, the dissolver is used only with a small aperture, being first circled in for a certain length of film and then circled out. The film is now run back

and the same operation repeated with the dissolver set near the edges. There is no limit in this kind of vignetted close-up. For this purpose the dissolver is fitted with a special stop device which gives the lever a limited movement; that is to say, the aperture can be set for any diameter.

One of the most important supplements to the round dissolve or iris is the mask box, which is detachably mounted to the front thread of the iris. The mask box has a rectangular opening in proportion to the picture size, which can be adjusted so as to be in perfect alignment with the aperture of the camera. A slot running through the mask box permits the cameraman to insert masks or cardboard cut-outs for vision and double exposure effects.

A most popular appliance is the double exposure device, which is designed for use in obtaining three different kinds of effects:

First, when the control lever is operated, the blades open or close in opposite directions, or when turned at right angle it gives the effect of two sliding doors, either for opening or closing a picture.

Second, the upper blade is detached from the control lever and fastened by means of a thumbscrew to the base, which leaves only the lower blade to be operated by the control lever. When the control lever is operated in either direction, it gives the effect of a rising or lowering curtain in front of the scene.

Third, the blades may be used independently, *i.e.*, set by hand for double exposures, so as to divide the stage in two or more parts. This scheme is especially useful where one actor plays a dual rôle in the same

scene. The diffused division line of the first exposure will readily blend with the division line of the second exposure, thus leaving no line at all in the finished picture. In this respect this method of making double exposures, vision effects and so on is far to be preferred to the camera mask method, because the masks of the camera often do not fit with sufficient accuracy to make good double exposure effects. The dividing line is generally too conspicuous when using camera masks, thus ruining the effect.

The double exposure and square dissolving devices are best used in front of the mask box and can be readily removed when not required. The double exposure device and the square closing device are two separate devices and are designed to be used interchangeably.

Double exposures which show a corner or the center double exposed are made with the help of the mask box into which a cardboard piece of certain shape is inserted, thus blocking a portion of the picture which has to be exposed after the film has been run back in the camera, while a second mask made of cardboard is used for blocking the first exposed portion. This can be done in any desired shapes, and the effect can be varied by using yellow or green celluloid instead of the cardboard, thus giving the appearance to the picture of the so-called spot-light. The cut-out portion of the celluloid naturally results in part of the picture being thoroughly exposed, while the solid portion of the celluloid retards the passage of light and results in an under-exposed area of the

picture. The effect is a clear, well-defined section of picture framed by a diffused section through which the remainder of the scene can be noted, like a picture taken in a fog. The effect is most pleasing when the round closing device is fitted with amber leaves instead of steel leaves, or when the regular round closing device or iris and the amber leaves device are combined, using both alternately for making double exposed circles, which circle in and out, showing only a fine line circle which is gradually getting smaller or larger, when lever is operated, and showing on the inside a different picture than on the outside in changing from one scene to another. For this purpose it is sometimes possible to connect the two devices with the camera mechanism in such a manner that they will close or open when the crank of the camera is turned, otherwise it is impossible to make the fine line circle.

But all these effects get into the more profound kinds of camera work which, as already stated, are out of the amateur province, which is the only one with which this work attempts to treat. These effects are only mentioned by way of general information and in order to give some idea as to what can be done by the resourceful amateur cinematographer, by means of iris attachments, celluloid slides, double exposure masks, and so on, either manufactured or home-made.

The Fade-Out and Fade-In

The one effect that should interest the amateur cameraman is the fade-out and fade-in, which is that

effect where the entire picture gradually darkens until it disappears in total blackness, or the reverse effect, where the total blackness gradually lightens and develops into a perfectly illuminated and detailed image.

This effect can be produced in two ways, viz.: The iris diaphragm of the lens can be gradually closed or gradually opened, to obtain the fade-out or the fade-in effect. This effect, it will be noted, is nothing more than the gradual under-exposure or the increasing exposure of the negative. However, when using the iris diaphragm of the lens for this purpose, it is generally impossible to obtain a perfectly tight closing diaphragm. The leaves only close down to a pin-hole, which means that it is virtually impossible to obtain absolute blackness in the screen effect, particularly in the high lights. It is true, of course, that the cranking can be speeded up when the lens has been closed as far as it will go, and the cameraman can place his hand in front of the lens to close off the light altogether. But these are improvisions, and improvisions are not generally favored in careful work. They are only mentioned here because the cameraman working with a camera that is not provided with one of the automatic fade-in and fade-out devices may make use of this improvision.

So popular is the fade-out and fade-in effect that cameras have for some time back been provided with automatic devices for accomplishing same. The first attempts along this line were to provide an automatic arrangement within the camera for gradually closing or opening the lens diaphragm. However, as

already stated, the lens diaphragm is not an ideal method.

The present method of achieving the fade-out and fade-in is by varying the opening of the revolving shutter, and has been described in the various specifications of standard cameras given in a preceding chapter. The two leaves of the usual camera shutter are gradually brought together so as to permit less and less light to pass through, or the reverse operation for the reverse effect. This can be done by hand where quick fade-ins or fade-outs are desired, or can be accomplished automatically by the camera mechanism.

Not only is the fade-in and fade-out effect of value for opening or closing a film or a scene, because it is gradual and not abrupt, but it also permits of dissolving, that is to say, blending or flowing one scene into another without a gap. For this effect the first scene is faded-out in so many feet or turns, a careful count being kept of the action. Then the lens is covered, so as to cut off the light, and the film is wound back into the top or loaded magazine by counting as many turns or number of feet as were used for the fade-out. Then the lens is uncovered, and the next scene is faded-in in the same number of turns or feet as the fade-out. Thus it will be noted that while one scene is growing dim, the overlapping one is getting brighter, so that the two lap over and there is nothing but a pleasant blending effect from one scene to the other without a break. A somewhat similar effect is also obtained with the iris vignetting attachment already referred to.

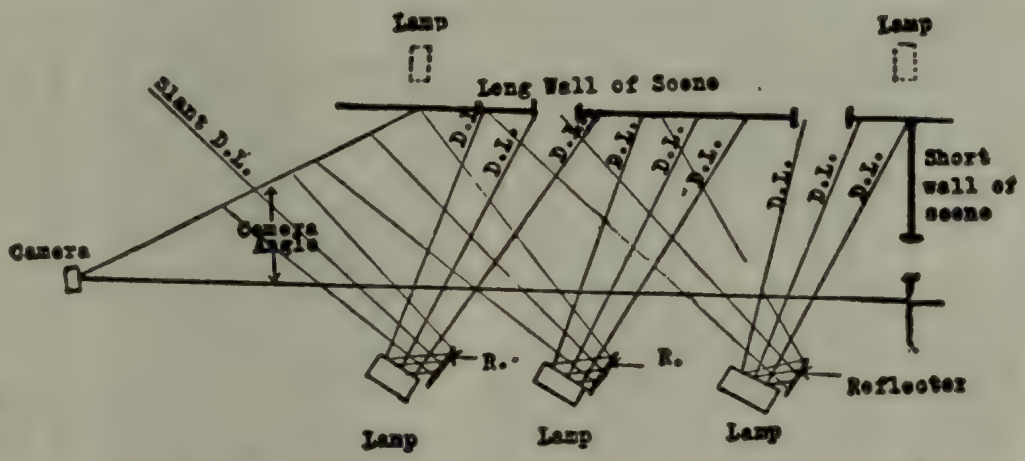
Filming by Artificial Light

So far we have only dealt with filming by daylight. There are many instances where motion pictures must be taken in dark corners of buildings where daylight never penetrates in sufficient volume, if at all, to permit of photography. Motion pictures being nothing more or less than snapshots, it stands to reason that a great volume of intense illumination is required for proper exposures. One cannot imagine how much light there is in sunlight until one attemps to get along with artificial light. In fact, an amateur's troubles begin when it is necessary to resort to artificial light. The expenses also mount up when we turn from daylight to artificial light.

A large amount of light is required in motion picture work, because of the short exposures (1/30 to 1/50 second) and need for definition, we learn from Wm. Roy Mott of the Research Laboratory, National Carbon Company, in a recent paper read before the Society of Motion Picture Engineers. The pictures are only 1 inch by ¾ inch in size on the celluloid film. These are magnified over 10,000 times in area on the screen and therefore need to be taken with greatest sharpness. There are sixteen pictures per foot and these sixteen are moved through the camera or projector in about one second. Each picture is brought into exact position with a closed shutter. This shutter is then opened for about 1/30 second and the exposure is made. In case of projection the eye in this period receives the full impression of the picture and by the persistence of vision retains the

image perfectly for the next 1/20 second during which the shutter is closed and the screen blackened until the next picture is exactly placed.

So much for this short resumé. Now in the interest of definition and depth of focus it is highly desirable to work with small lens opening. For instance, with the white flame arc lights, F:5.6 is often used in motion picture studios whereas F:4.5 and



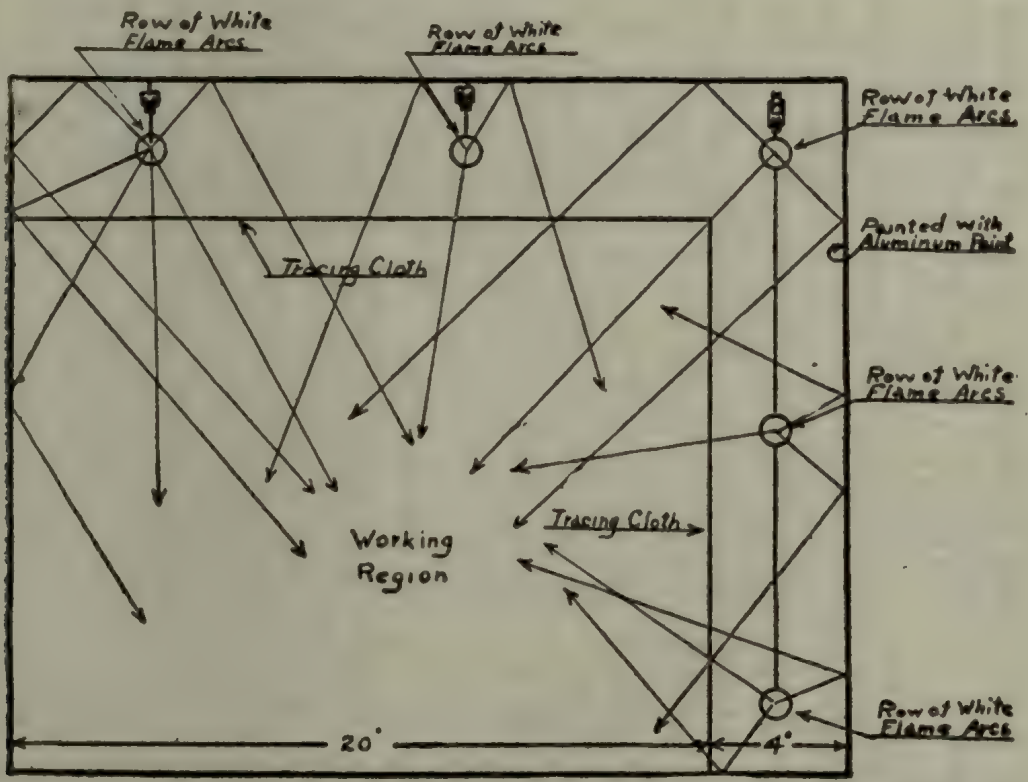
Typical arrangement of side lights in making a studio scene. Note how reflectors are placed on the lamps.

even F:3.5 have been recommended with other sources of artificial light. Some of the flame lamps, with their reflectors and diffusing screens, can be used to give a light intensity of 10,000 and more candles per square foot, so that even daylight is surpassed if so desired. While in ordinary artificial lighting 5 and 10 foot-candles is good illumination, yet on the moving picture stage at least a hundred times this should be used. This means a stage illumination of 500 to 1,000 foot-candles as a minimum.

For interior scenes daylight must be diffused to

Batteries of mercury vapor lamps in a typical studio. The overhead lamps are mounted on trolleys so that they can be moved to any part of the studio. The floor lamps are mounted on wheeled stands so that they can be moved about.

avoid outdoor appearances caused by the direct shadows from the sunlight. This diffusion is secured by using prism glass in the roof and sides of the studios. If the studio work for interior scenes is done outdoors, then awnings of light sheeting or muslin are used to secure proper diffusion and this is sometimes done in studios with glass roofs, espe-



An arrangement of diffused lighting which is obtained by means of flaming arc lamps, a wall painted with aluminum paint, and a tracing cloth screen.

cially if clear glass has been used. A serious objection to daylight in such studios is the hothouse effect, especially in summer. As these glass houses receive continuously one to two horsepower of solar energy per square yard of projected area normal to

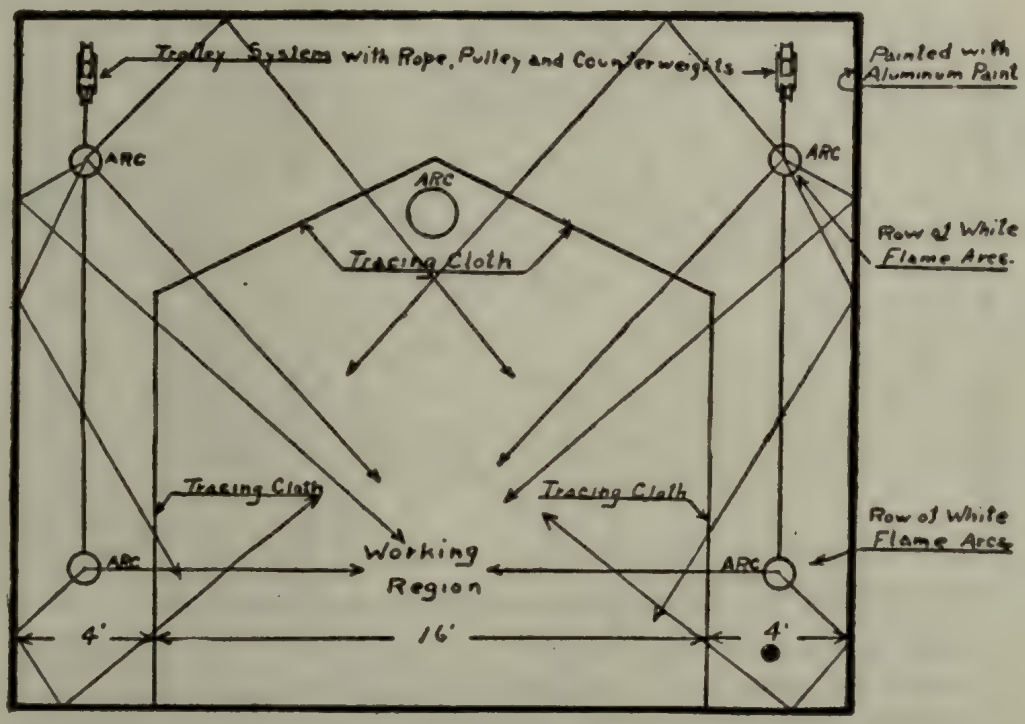
TABLE OF WHITE FLAME LAMPS USED IN MOTION PICTURE STUDIOS

Compiled by Wm. Roy Mott, Society of Motion Picture Engineers

Flame Lamp	*Amperage*	*Chief Lamp Characteristics*	*Flame Carbon Trims* *Upper*	*Lower*	*No. and Position of Flame Arcs*
Allison & Hadaway	15-25 A	Suitcase Portable	½x4″W.F.	⅜x4″W.F.	Twin Vertical
Aristo	28 A	Conv't'd Encl'd Arc	½x12″W.F.	½x6″W.F.	Single Vertical
Bogue	25 A	Stand (Photo-eng.)	½x12″W.F.	½x6″W.F.	Sin. & Twin Vert.
Butler Super Power	15 A to 55 A	Widely Adj. Amp.	½x12″W.F.	½x6″W.F.	Sin.Vert.Adjust'ble
Chicago Stage Lamp	25 A	Right Angle	⅜x12″W.F.	½x6″E.A.	Right Angle Arc
Conv'd Enclosed Arc	15 A to 70 A	Shunt (Adjustable)	½x12″W.F.	½x6″W.F.	Single Vertical
Joyce Flame Arc	25 A	Stand (Photo-eng.)	½x12″E.A.	⅜x12″W.F.	Single Vertical
Klieglight	15-30-40 A	Port. & Hvy. Stand	½x4¾″W.F.	½x4¾″W.F.	Twin Horizontal
Macbeth Tilting	25 A	Stand Tilting	½x12″WF(AC)	½x12″W.F.	Sin.&Tw.ArcTilting
Scott	15-20 A	Inclined Trim	⅜x11-32″x12″ W.F., (D.C.)		Twin Inclosed Trim
Simplex	15-25 A	Suitcase Portable	½x4″W.F.	⅜x4″W.F.	Twin Vertical
Stage Spotlight	50-100 A	Spot Lighting	½x⅝″x6″W.F.		Sin. Flame Spotligh
Sunlight	120-150 A	Searchlight	⅝x12″W.F.	½x7″W.F.	Flame Searchlight
Universal	15 A	Tilting	⅜x12″W.F.	½x12″W.F.	Twin Arc Tilting
Wagonhoarst	30 A	Reactance A. C.	½x12″W.F.	½x6″W.F.	Twin Arc Vertical
Wohl Tilting	25 A	Portable Tilting	½x6″W.F.	½x6″W.F.	Twin Arc Tilting
Wohl Duplex	30 A	Side and Overhead	½x12″W.F.	½x5″W.F.	Twin Arc Vertical
Wohl Broadside	30-60 A	Powerful Stand	½x12″W.F.	½x5″W.F.	Four Arcs Vertical

Abbreviations: A = Amperes. W. F. = White Flame. E. A. = Enclosed Arc.

the light, the heating effect is many times greater than with good artificial light alone, because the full amount of artificial light is used intermittently and seldom for more than a total of an hour a day. The artificial light used generally for side illumination with daylight should be given by the light of the greatest photographic power in proportion to the

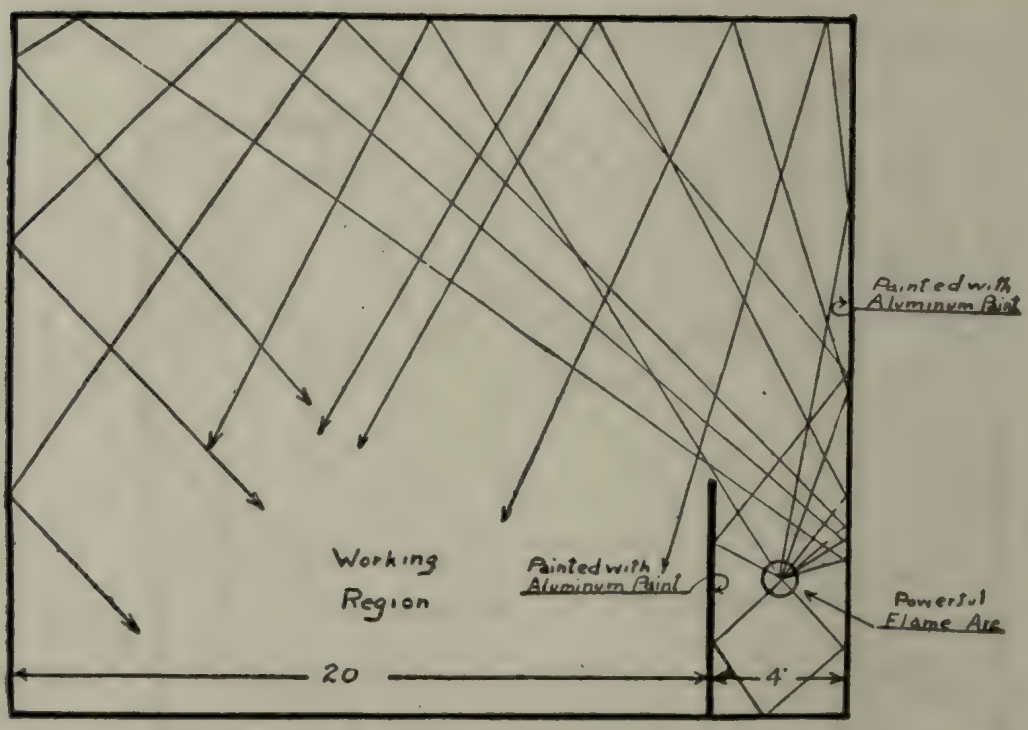


Another lighting arrangement which calls for arc lamps, aluminum painted walls and tracing cloth. The tracing cloth gives a rare degree of diffusion which makes for pleasing studio pictures.

energy liberated in the studio. For this reason flame arcs are commonly used with daylight. In the winter daylight is rather poor after penetrating the glass and screen, and so dependence is largely placed on the artificial light.

The white flame high amperage arc, states Mr.

Mott, gives a light which is remarkably close to daylight in both color and photographic values. Like daylight the spectrum is not entirely continuous, but the effect of being practically continuous is obtained by the enormous number of light-giving lines in



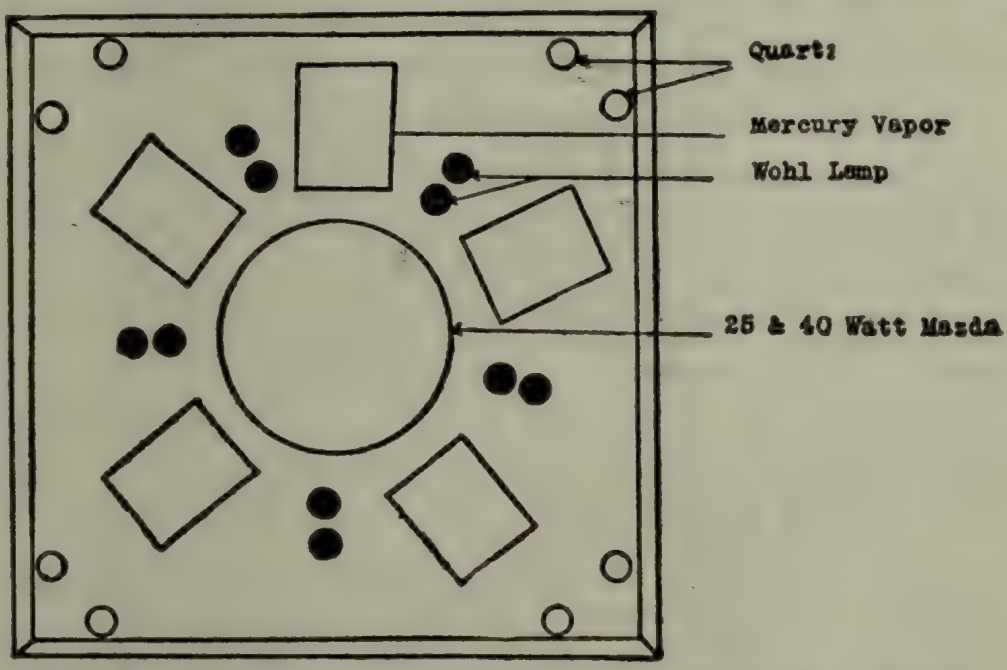
Still another lighting arrangement on a small scale, in which a single powerful arc lamp is employed, together with aluminum painted walls for diffusion.

every part of the spectrum, including the ultra-violet, which with the white flame arc is very similar to that given by sunlight.

The Question of Make-Up

In make-up the motion picture artist soon learns that red will photograph black because the ordinary film is not sensitive to red light. For this reason the

make-up of a moving picture artist should not include rouge on the cheeks (and it is best to avoid having gold-filled teeth). On the other hand, an excessive amount of white clothing should be avoided as this may give rise to halation which results in a blur. Hence yellow, gray, and other colors of clothes are



Lighting arrangement for illuminating a prize fight. The lights in this case are suspended over a prize ring, out of the way of the fighters.

used. This halation, Mr. Mott assures us, needs to be watched carefully with the lights having low latitude on the photographic plates. It is interesting to note that the light of the white flame arc shows a very wide latitude on films. This means the picture will show parts highly lighted and dimly lighted with clear definition.

In regard to film sensitiveness the ordinary motion picture film has a maximum sensitiveness in the vio-

let with considerable sensitiveness in the blue and ultra-violet and much less in the green and yellow, and no sensitiveness in the red. Some motion picture laboratories are making orthochromatic films fairly sensitive to yellow light. For panchromatic photography and color photography, of course, all parts of the light are used. Because of the use of a yellow screen with these, special flame carbons can be used not only to give more light, but such light that a screen of better transparency can be used. But we are getting beyond our field again, so let us return to our modest premises.

The flame arc, according to the same authority, shows a rapid increase in actinic light with increase in current. In fact, the flame arc with doubling of the current at the same arc voltage increases its photographic effect not twice but three to four times. This makes it profitable to use the flame arcs at high amperages of 15-25 to 35 amperes. In some cases much higher amperages have been used. The enclosed arc lamp soon reaches a limit of current because of the danger of globe melting down; or if a very large globe is used, then the amount of air at the start decreases the initial efficiency, which is very important in motion picture work because the actual scenes are short and usually last from ten seconds to a minute or two.

A vertical flame arc is generally preferred, but the arc will burn well in a great variety of positions. In general, flame upper carbons and flame lower carbons are used in motion picture flame lamps so that the lamps can be used on either direct or alternating

Typical back-lighting arrangement in a studio, showing how a single spotlight is employed to illuminate the heads of the players. It is this back-lighting effect that gives present-day pictures their remarkable relief.

current and without any regard to polarity if it is direct current. This arrangement is different from the photo-engraving field, where a very common trim is a neutral enclosed upper carbon with a white flame positive lower. In this case the flame carbon must always be made positive because the flame chemicals travel through the arc stream from the positive crater to the negative crater. It is the flame materials that produce the light, and wrong polarity or pure carbon open arc gives about one-sixth the photographic light of the white flame arc. However, a positive flame upper carbon gives better efficiency with a flame negative lower as against a neutral negative lower.

On alternating current, both carbons should be flame carbons, as here the flame material feeds from both electrodes, and so this arrangement gives the maximum efficiency.

Special flame lamps have been developed to operate on alternating current or direct current and in series on 220 volts or in parallel on 110 volts. This makes the lamp of universal use, and calls for no special attention to the electrical conditions. The resistance of the flame lamp to mechanical shocks, electrical shocks such as over-voltage, and to bad weather conditions, has made it universally used for outside motion picture work. Combined with all these advantages is the remarkably small weight of these lamps. For instance, some of the twin arc lamps weigh no more than 20 pounds for lights giving 8,000 or more horizontal candlepower, and with the light of a little greater actinicity than daylight.

The amount of light is probably greater in proportion to weight than any other artificial light used in motion picture studios.

There are many different kinds of flaming arc

Pair of spotlights mounted on a swivel bracket in one of the Western studios and especially intended for back-lighting effects. Note the enclosed switch on the back of each lamp house which ensures absolute and instantaneous control of the lighting effect.

lamps available for the permanent installation of the amateur studio, and for portable purposes. For

illuminating limited fields, the amateur cameraman need not have more than two small flaming arc units, each of the twin-arc type. There is the Aristo lamp, for instance, which is an enclosed arc lamp which has been much used in portrait studios and in motion picture studios. It is used with or without the globe. Then there is the Allison and Hadaway lamp of twin-arc design, which is especially intended for portable uses in its suit-case form. Another model by the same company has a diffusing cabinet with flame lamp, and still another, a small amateur flame lamp is provided with shunt control to raise greatly the current at the time of taking the pictures. The horizontal candlepower of the 15-ampere flame lamp is said to be 8,000.

Lights for Getting Along Without Daylight

Then there is the Klieglight portable, with twin arcs and of light construction. The Simplex lamp is a twin flame lamp which is quite portable and can be carried around in a suit-case. This lamp is designed for 15 to 25 amperes. There are many other portable lamps suitable for the amateur cameraman in search of satisfactory illuminants of moderate power. One of the most satisfactory is the new Spectro twin arc portable lamp, which operates on either direct or alternating current without adjustment and produces 15,000 candle power of light rich in actinic rays. The lamp proper is made in one piece, mounted on a light stand that is adjustable for any height or angle, and supplies four hours of steady illumination without any attention.

Lighting is a highly technical subject and we cannot afford to go very deeply into it in the limited space at our disposal. Suffice it to say that the

Typical spotlights employed in a Western studio, the one on the right being provided with a switch control. These lights, it will be noted, are used to illuminate some particular part of the scene, and do not figure in the general illumination.

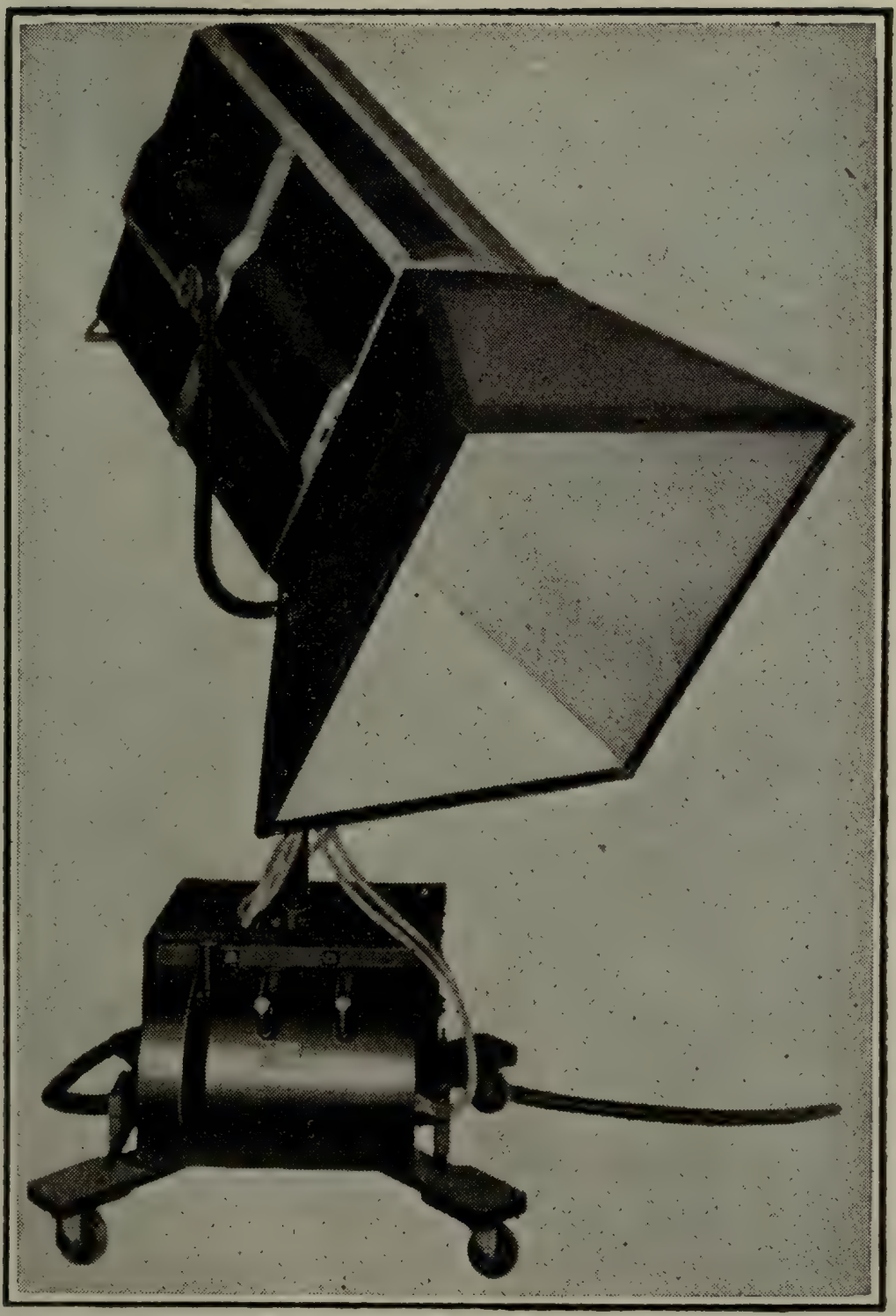
excellent pictures of today are in a large measure due to the lighting effects, which are in the hands

of skilled electricians and photographers who have a fine sense of the artistic. In fact, if the pictures of today are in such relief, with so much depth and feeling to them, it is due to the masterly handling of the illumination.

In the usual motion picture studio the lighting is divided into two broad classes, namely, the overhead lighting and the side lighting. The overhead lighting may be either diffused or concentrated. The overhead lighting serves to flood the entire set below with the necessary primary light, so to speak, while the side lighting, supplied by powerful flame arcs mounted on stands that may be wheeled about to any position, provides the special lighting effects. The best lighting for the usual motion picture stage, we are told, calls for 50 per cent. more side lighting than top lighting.

The use of real scenery in place of painted scenery gives, according to Mr. Mott, the best results. Real scenery should be lighted from the side. Painted scenery should be lighted directly from the front with the light striking nearly perpendicular. If the scene is set up with painted scenery, two sets of lighting should be used if possible, one for the foreground and the other for the painted scenery. This same principle applies to panorama where near objects are lighted in one way and the panorama in a different way to give suitable blending of the illusion.

Diffused light is advantageous in cutting out the harsh black shadows and giving what is known technically as luminous shadow effects. Most arc lamps are provided with special diffusers, such as spun-



Large flaming arc light for side lighting. The switch controls for the arc units of this lamp are provided at the base, and the lamp may be wheeled about as a complete lighting outfit.

glass sheets, that can be used when diffused lighting is desired. Diffused light can also be obtained by indirect light; that is to say, the light from the lamp is directed on some reflecting surface and from that surface spread over the scene to be illuminated. But the photographic intensity of the light should be very high in order to get the camera to operate satisfactorily with the F:5.6 opening. The flame arc can be used with a camera lens at F:5.6 to give good lighting on a small stage with 20 kilowatts of energy. The jump from F:5.6 to F:4.5 or even F:3.5 makes a big difference in the definition and clearness of the picture. The depth of focus can be maintained better, of course, with F:5.6, and because of the important artistic value of the background and the great distances with rapid movements that should be covered, it is highly desirable to work with a good depth of focus. In general, the motion picture stages will use with flame arcs the following amounts of power when having the lens at F:5.6.

Small stage....	20 kilowatts	4 to 6 flame lamps
Medium stage..	50 kilowatts	10 to 16 flame lamps
Large stage....	100 kilowatts	20 to 32 flame lamps

Using the larger opening of the lens, F:3.5, as low as 20 kilowatts with flame lamps can be used to secure the illumination of large stages. These figures are given here not so much because the amateur cinematographer, for whom this work has been prepared, may be in need of such data, but rather to show the gigantic problems in the way of tackling ambitious things. When the amateur cinematographer plans

indoor scenes, he should think of the illumination required and limit his field of action to the smallest possible compass. Two flaming units are sufficient for illuminating a very small stage, such as is used for close-ups. The author has made use of two small portable arc lamps for filming scientific subjects with a field no larger than 10 feet deep by about 10 feet wide, with the lens set at F:4.5

Aside from the flaming arc lamps, there are the mercury-vapor tubes which provide excellent illumination in the case of permanent installations. For portable and general amateur use perhaps such lamps are not as satisfactory as the arc type, because they are more subject to breakage and are more bulky. They have certain advantages over the arcs, however, which have caused them to be used in many of our leading studios. For one thing, they are steady. Again, the light is far less trying on the eyes, and there is little heat. There are also the nitrogen-filled incandescent bulbs of high candlepower. However, it requires a great number of these bulbs to illuminate a small sized stage, and in the long run the arc lamps prove more satisfactory and less costly.

Unloading the Camera at the End of the Day

The camera, after being used for a given job, should be unloaded. The film that has been exposed is contained in one of the magazines, while the other magazine is entirely empty if all the film has been used. If some of the film remains in the first magazine, it is best not to waste the few feet of film necessary to rethread the camera unless the exposed film is ur-

gent, in which case the camera is opened, the exposed film cut, the lower or take-up magazine taken out, an empty magazine put in its place, and the camera rethreaded.

The spindle of the magazine containing the exposed film should be turned so that the free end of the film disappears into the box, if it has not already done so while in the camera. The magazine can now be brought to the motion picture laboratory for development, or the cameraman can do his own developing if he possesses the necessary equipment. In instances where the cameraman is dealing with a regular laboratory, it may be well for him not to send his magazine along, but rather to unload it in a dark room or under a blanket as described for the loading operations, or in a changing bag, and to place the exposed negative in the original black paper wrapping and tin can in which the negative came. Such a tin can is then sealed carefully with the same adhesive tape that came with it, or with fresh adhesive tape. Magazines cost a good deal of money, and laboratories sometimes lose them. If magazines must be sent to the laboratory, the cameraman will do well to mark his name on each magazine he owns, so that his property can be identified. It is also good practice to do the same thing with the negative film, at the time when the film has been placed in the magazine and the end protrudes out ready for threading.

Care of the Camera Lenses

The following suggestions regarding the care of lenses are given by the Bausch & Lomb Optical Com-

pany, and if put to good use will be found quite worth the extra trouble.

A lens should remain for an indefinite time in as good condition as when it leaves the manufacturer's hands, providing a few simple rules are observed, to which we draw attention.

Protect the lens as much as possible from dust and finger marks.

Keep the cap on the lens when not in use.

Do not subject the lens to sudden and extreme temperatures.

Do not expose the lens to the heat of the sun or steam pipes.

Avoid damp places.

Never use any sort of polishing material, alcohol, or other solvent on the lens or lacquer.

Never use acids of any kind for cleaning.

Do not allow the lens to fall or get a sudden jar.

Occasional cleaning is not only advisable, but also very necessary when the lenses show dust, finger marks or moisture on the surfaces.

To clean, use a well washed linen handkerchief only. If dusty, blow off the dust first, then wipe. To remove finger marks or moisture, breathe upon the surface, and wipe; always wipe lightly, and with a circular movement; a camel's hair brush is convenient to remove dust before cleaning, and afterwards to remove lint.

If the inner surfaces of the lenses require cleaning, the utmost care should be observed in removing the lenses one by one, cleaning them, and then replacing before others are taken out.

Should lenses or mounting require more attention than the afore-mentioned, do not entrust the same to any but the maker.

When the lenses are not in use it is well to keep them wrapped up so as to protect them from moisture, dust and so on. Either tissue paper or an old lintless rag is suitable for this purpose. In fact, all lenses should be provided with some kind of cap which is placed on the front of the lens when not in use. If the lens is removed from the camera, it is well to have two caps, one for the front and one for the rear.. In the absence of caps, paper caps or plugs will do quite nicely.

Chapter V.

DEVELOPING AND PRINTING THE FILM

FROM the camera the negative film, containing the latent images, must go to the laboratory for development, just as the kodak film or the glass plate of the still photographer must go to the dark room for finishing. There is this difference, however, that still photography is a relatively simple matter, and very little in the way of equipment and experience is necessary in order to do the necessary work. In motion pictures, on the other hand, with film measuring hundreds of feet in length and with developing solutions, fixing solutions and other solutions running into many gallons, it is obvious that a large collection of elaborate equipment is required.

Furthermore, in the case of motion picture negative, a good deal is generally at stake, and the lack of experience or knowledge in the handling of the film means a serious loss. Certainly it is no task for the amateur to attempt. There is no question but that all work, wherever possible, should be given to a regular laboratory, not only because of the superior results which may thus be obtained, but moreover for the reason that laboratory work on a small scale does not pay.

Then again, developing is only a small part of the laboratory routine. As soon as the film is de-

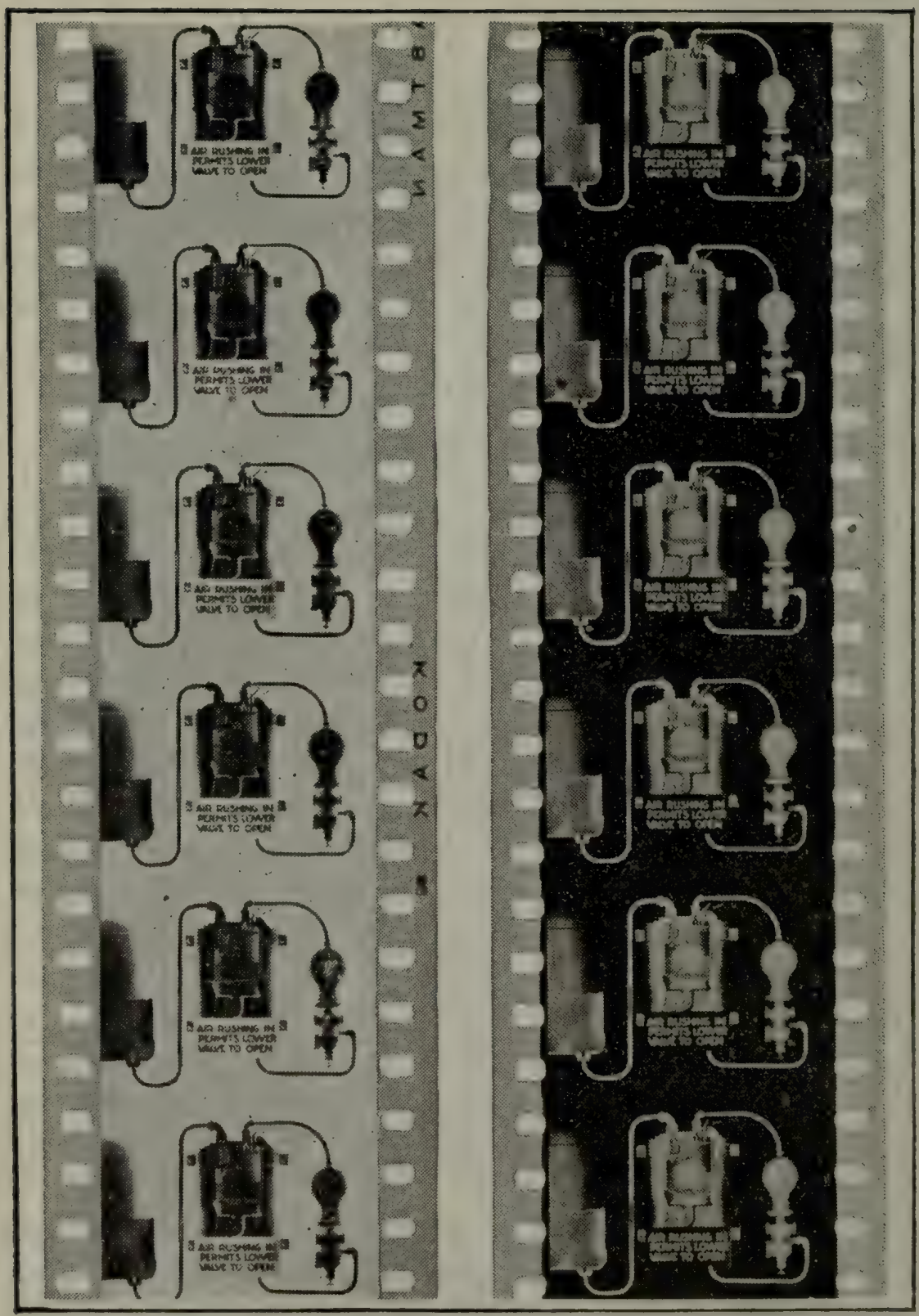
Dark room of the usual film laboratory. The film is wound on racks, while the developing operations are carried on in narrow wooden tanks, with no other light than that from dull ruby lamps.

veloped, it must be printed, and good printing calls for elaborate printing machines. The only time the amateur cinematographer is justified in doing his own laboratory work is when he is far removed from all laboratories, and time is the very essence of the undertaking. Then, and only then, is he warranted in undertaking his own finishing.

Elements of Laboratory Work

In brief, motion picture finishing calls for the developing of the negative film, just as it is received from the cameraman. Negative, as we have already learned, has an exceedingly fast emulsion and must be handled with considerable care to avoid fogging. The film, after it is taken from the camera magazine or the tin can in which the cameraman may have placed it, is wound on wooden racks with the emulsion side out. These racks take anywhere from 100 to 400 feet of film, depending on their dimensions. Once the film is wound on the rack, the rack is placed in a high, narrow tank containing the developing solution. The rack is vigorously shaken up and down a number of times in order to make sure that no bubbles or air bells, as they are called, cling to the film, which would give rise to clear spots on the finished film.

Now, as the average amateur cinematographer should know from his general knowledge of photography, negative development depends on several factors. First of all, there is the extent of the exposure of the negative, which may be underexposed, correctly exposed, or over-exposed, depend-



Strips of negative and positive film. The negative, shown at the left, is the film exposed in the camera, while the positive at the right is printed from the negative by the laboratory hands.

ing on the cameraman's skill—and luck. Then there is the strength of the developing bath, for a stronger bath develops the image quicker than a weaker bath. Third, there is the temperature factor, for the warmer the developer the more rapid its developing action. Fourth, there is the time factor, which depends on the exposure, strength of developer, and temperature of same. Thus with the strength and the temperature of developer known, the laboratory man can soon tell how long it will require for the complete development of any negative. If the negative is under-exposed, the correct development may not bring out sufficient density and it may be necessary to over-develop. Vice versa, with an over-exposed negative the correct development may make the negative too dense, and it may be necessary to shorten the development. But either of these measures are only improvisions, for it is becoming more and more realized that the place to correct such faulty exposures is in the camera, at the time of taking the pictures, and the laboratory remedies cannot be more than crude at best. So, with the temperature and the strength of the developer known, the laboratory man knows that so many minutes are required. It is an exact science.

After the developer has done its work, the film rack is removed with the frames clearly showing on the yellow celluloid ribbon. The rack is then placed in the "short stop," which is a solution intended to stop the developing action immediately. Then the rack is shifted into the hypo or fixing tank, where it is allowed to remain until the free or unexposed

silver, which appears as the yellow background for the images just out of the developing tank, is removed. From the fixing tank the rack goes to the washing tank, where the film remains until every trace of hypo is removed.

The film, being quite wet, of course, must now be dried. For this purpose the film rack is brought to the drying room, where the film is unwound from the rack and wound on to large circular drums, emulsion side out. These drums, revolving at a speed that is sufficient to spread out the drops of water so that rapid drying is secured, are located in a warm and dry room which further hastens drying. In some instances only twenty minutes' time is required to dry a given film.

From the drums the dry film is wound into a roll, ready for examination, after which it is passed on to the printing department for the purpose of making one or more prints. This process is analogous to the printing process in still photography. The negative, face to face with the unexposed positive stock, the emulsion of which is considerably slower, is drawn through the mechanism of a printing machine. There are two general types of printing machines, namely, the step-by-step type and the continuous type. In the step-by-step printer, which is in common use, the films are shifted one image at a time after each exposure, in a very similar manner to the operation of the camera and the projector. In the other type, the continuous projector, the two films, face to face, are continuously moved past a window through which the light passes in order

Drying drums of the usual laboratory. The wet film, after being thoroughly washed, is wound off the racks and on to the huge drums, which are kept revolving all the while so as to cause even drying of the film. Film can be dried in as little time as twenty minutes in many of our well-equipped laboratories.

to make the impression. The continuous printer, because of its simplicity, is generally used for amateur work.

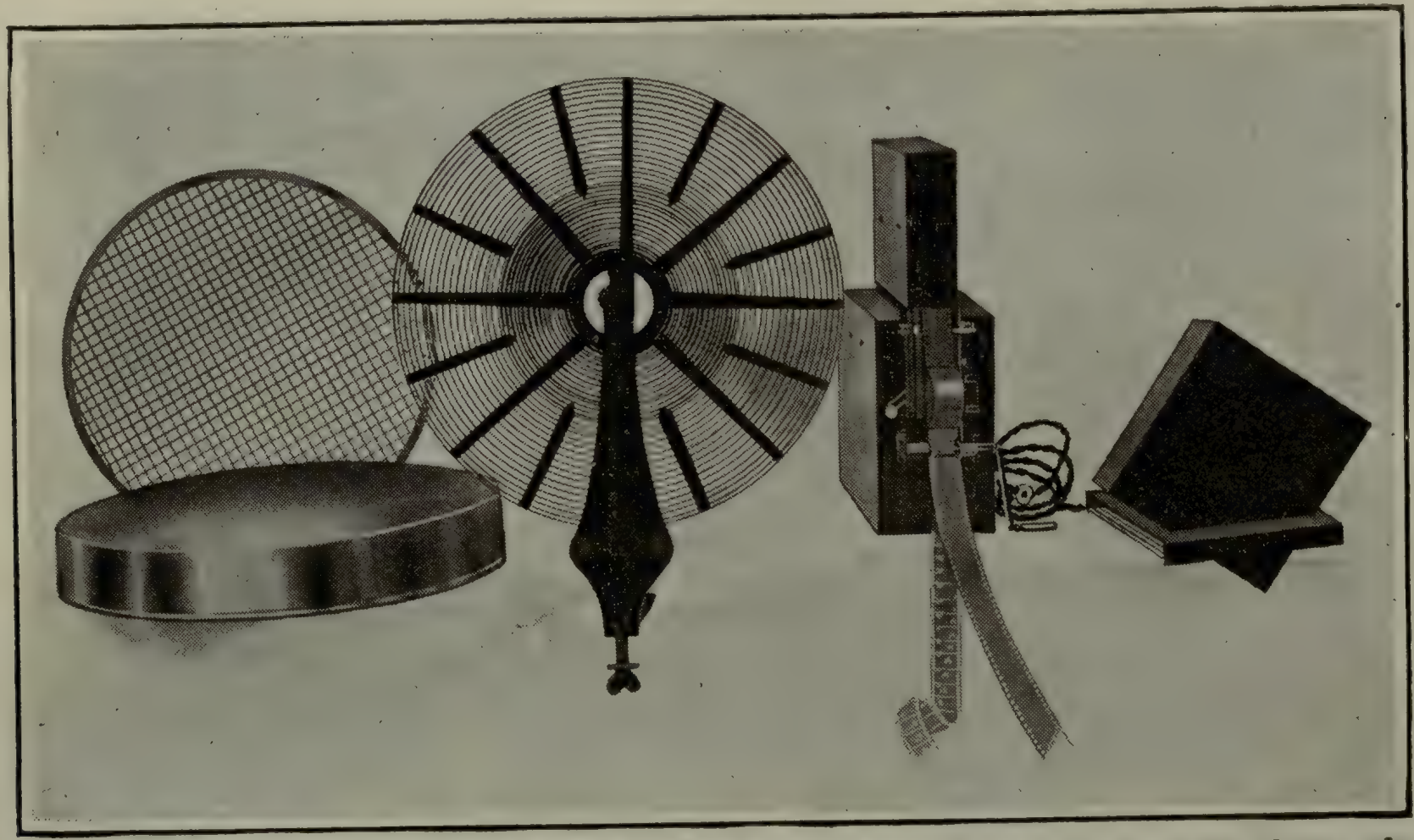
After the positive film has been run through the machine in contact with the negative, it is sent to the positive dark room, where it is wound on a rack and developed, fixed and washed, followed by drying, in the same manner as the negative film, except that the work can be carried on in stronger ruby light.

That, in brief, explains the laboratory work. It is useless to go into details for the reason that this is quite out of the amateur field. However, there are on the market a number of outfits intended for the man who must do his own darkroom work, especially the traveler and the explorer.

Laboratory Work on a Miniature Scale

Perhaps no equipment is better adapted to amateur laboratory work than the Stineman system, which is the invention of R. P. Stineman of Los Angeles, Calif. Here is a little outfit that can be used to develop two hundred feet of film in two gallons of developer, yet can fit into the ordinary suit-case. It is made of metal, which ensures long wear. The emulsion is not touched by the hands or equipment, hence clean work is assured. Pyro or any other developer may be used with equal success, since the tanks and rack are acid-proof.

In brief, the Stineman system consists of shallow pans for the developer, fixing solution and so on, a special developing reel which takes the film, a print-



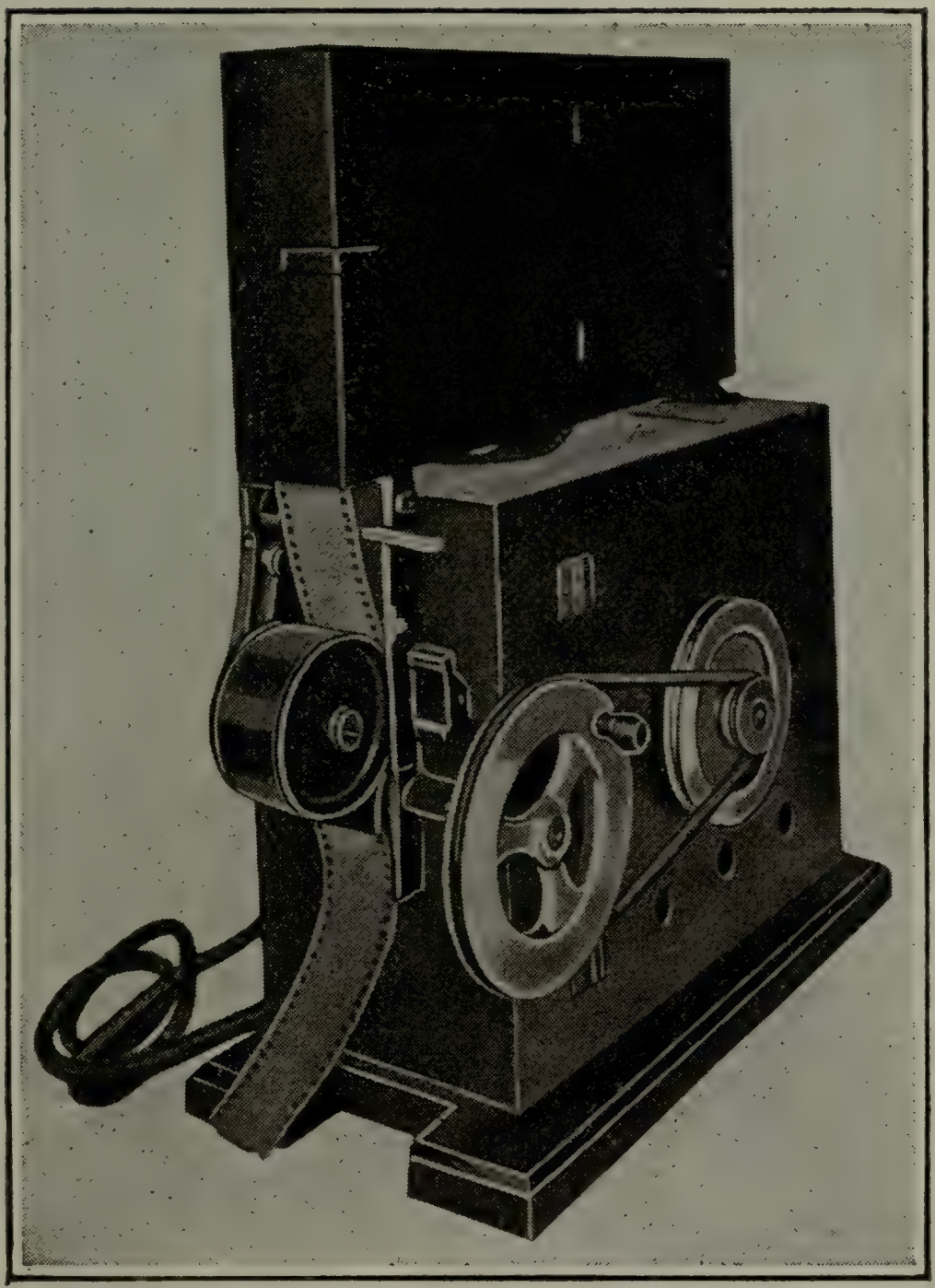
Small amateur film developing and printing outfit which may be used by those who prefer to do their own finishing. The film to be developed is placed in the large spiral shown, and placed in flat pans. The machine at the right is a small hand-driven printer.

ing machine when prints are to be made, and other accessories. The smallest outfit consists of three nesting tanks and one fifty-foot reel, while a special traveling outfit consists of three nesting tanks and one 100-foot reel. As many reels as are deemed necessary can be employed, in order to expedite work. Two hundred-foot reels can be had for studio work, where the matter of portability is not being considered.

To develop a film by means of the Stineman outfit, it is only necessary to place the spiral reel on the stationary winding pin at a convenient angle to the film magazine so that the film will slide smoothly into the reel. The end of the film is fastened to the slot or slipped over the peg, in the center of the reel, and the reel is then revolved with the left hand, using the right hand against the outer edge of the film to guide it into the reel. When wound, the other end of the film is fastened to the reel with a metal clip. The film should be firmly wound into the reel and fastened with a clip. Of course, this work has to be done in a safe darkroom. A beginner should practice winding an old piece of film into the spiral reel until he can handle it smoothly and become familiar with the operation.

The reel is then picked up by its center member and immersed in the developer pan or tank and moved rapidly up and down several times to prevent air bells or bubbles. When using pyro developer this operation should be repeated several times during development to prevent air bells.

When the development is complete, the reel is

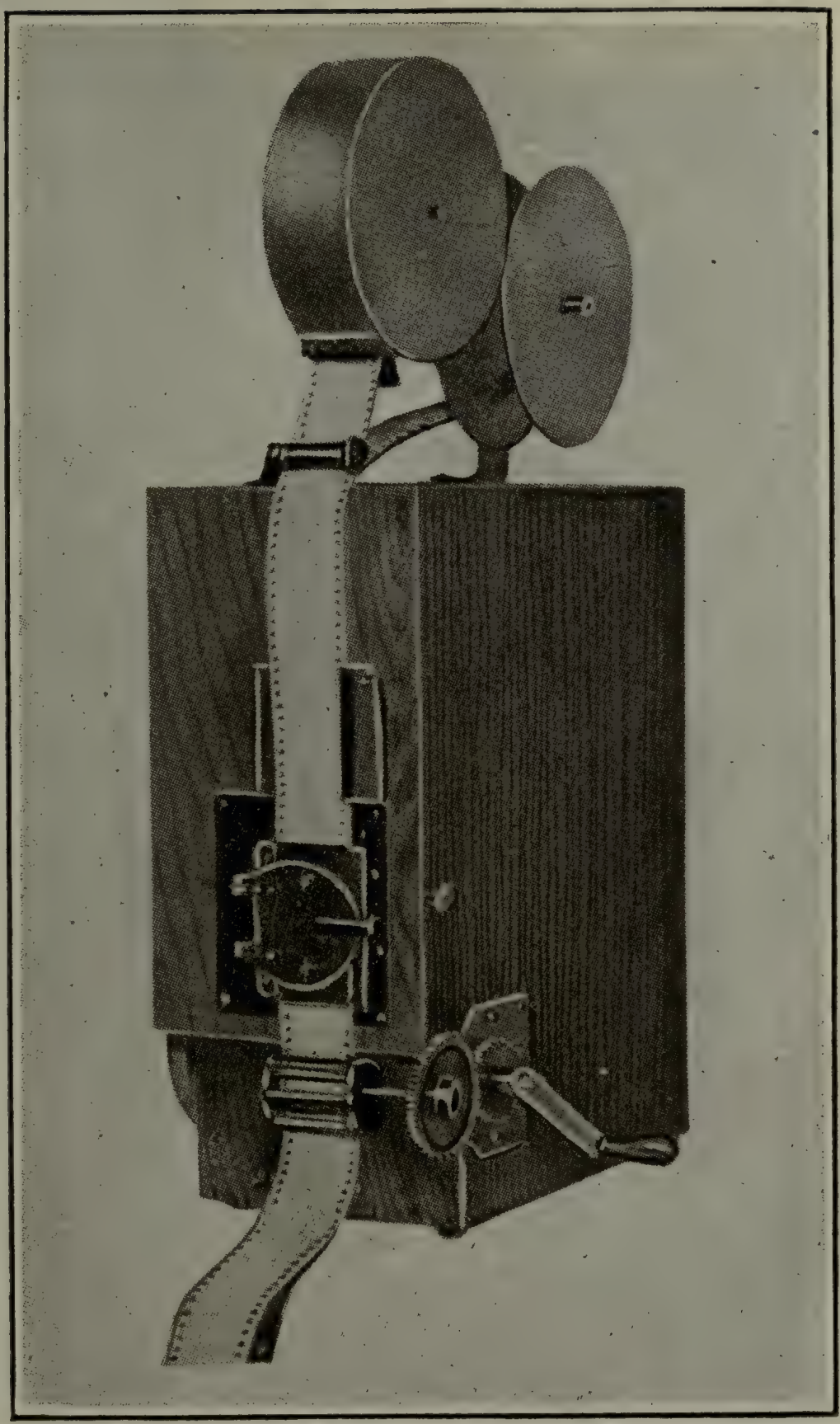


Hand-printer employed with the amateur finishing outfit shown on page 211. This little printer is cranked at about the same speed as the camera, while the illumination is supplied by a connection with any light socket.

removed, rinsed, and placed in a pan containing the hypo or fixing solution. After fixing, the reel is placed in the pan of clean water and thoroughly washed. Water or hypo should not exceed three inches in depth, for if it is too deep in the tank it will float the film out of the reel. When thoroughly washed the ends of the film are released and the reel is lifted out of the water and drained for a few seconds. After that the reel is placed face down on the screen that comes with the outfit, in about four inches of water. Then, by grasping the reel by finger holds on the reverse side in the center, the reel is agitated slightly and raised gradually, leaving the film on the screen. The next step is to raise the screen out of the water, place it on the stand with the revolving top, and wind the film on a drum or rack to dry. The film is not touched at any time, the reel being always lifted by the handle in the center.

The Stineman system also includes a small printing machine, which takes 200 feet of positive film in its magazines at one loading. The printer weighs about eight pounds, can be connected to any electric light circuit, and is operated by hand at about the usual camera speed. This little printer is excellent for making test prints in far-off places.

There are other developing outfits of the same general character, making use of shallow tanks, flat reels for taking the film in a spiral form, and hand-driven printing machines which are usually of the continuous type. The ingenious amateur can perhaps make some of this apparatus himself. The



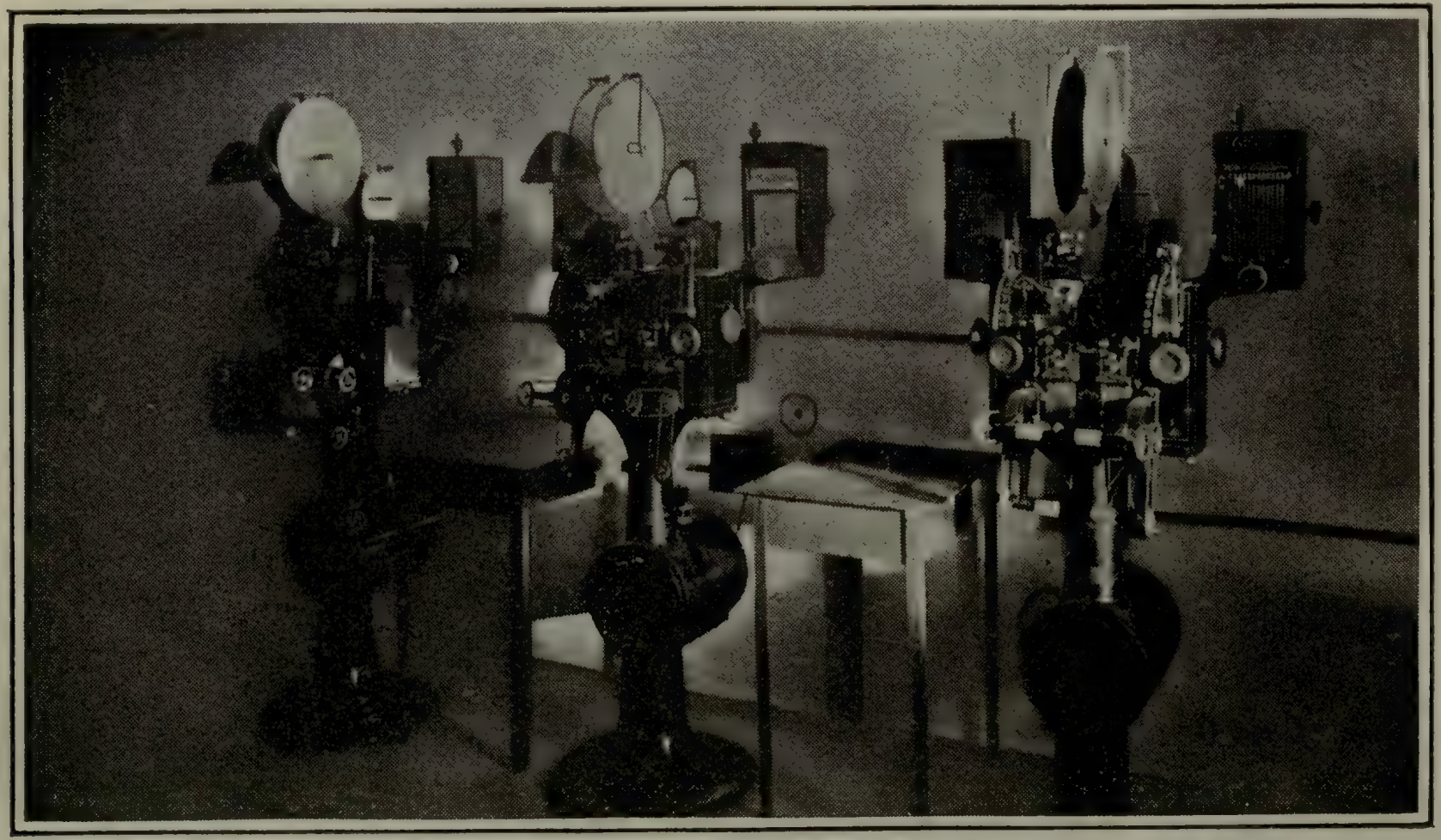
Another type of hand-printer, which is available for the modest requirements of the amateur.

developing apparatus is not difficult, for two cross-arms placed together, provided with pegs at ½-inch intervals along the resulting four radial arms, may be used very nicely as the reel, while wooden boxes of the proper shape, lined with sheet rubber, may form the shallow tanks. The advantage of the shallow tanks for short lengths of film is that they require a relatively smaller quantity of developer, but for regular laboratory purposes the deep narrow tanks are employed because of their relatively small exposed surface. Exposed surface with most developers means rapid oxidation, and in laboratories where solutions are in constant use for several days or even a week before they are completely exhausted, the question of reducing oxidation to a minimum is naturally an important one.

As for printing, the handy amateur may possibly be able to devise some form of continuous printer from a collection of odd sprockets and idlers, and a simple case containing the lamp. But perhaps the better scheme is to make use of a discarded motion picture camera or the head of an old projector, so as to have a step-by-step mechanism.

Developing Solutions for Negative

Should the reader be anxious to do his own developing, he may be interested in the following formulæ which are considered as standards. Of course, the average laboratory man soon works out his own formulæ for various kinds of film, because his experience teaches him that he can obtain better results under the conditions peculiar to his establish-



A battery of typical printing machines. The roll of negative film, face to face with the roll of fresh positive stock, is drawn past an illuminated aperture one frame at a time. A shutter permits the light from the illuminated aperture to pass through the negative and on to the positive emulsion.

ment with certain modifications from the usual standard practice.

The formula recommended by the Eastman Kodak Company for the development of Eastman negative is as follows:

	Avoirdupois	*Metric*
Water (8⅓ Imperial gals.)	10 U.S. gals.	40 litres
Elon	180 grains	12 grams
E. K. Co. Sulphite of Soda	3 lbs. 5 oz.	1590 grams
Hydrochinon	8 ozs.	240 grams
E. K. Co. Carbonate of Soda	1 lb. 9 ozs.	750 grams
Potassium Bromide	1 oz. 63 grs	36 grams
Citric Acid	400 grains	28 grams
Potassium Metabisulphite	2 ozs.	60 grams

☞ Maintain temperature at 65 degrees Fahr.

A good pyro formula is as follows:

Pyrogalic Acid.....	½ oz.
Nitrous or Sulphurous Acid.....	20 minims
Water.....	32 oz.
Sulphite of Soda (Crystals).....	6 oz.
Carbonate of Soda (Crystals).....	4 oz.
Water.....	32 oz.

To develop a strip of film, the worker should take 10 oz. of the pyro solution, 10 oz. of the soda solution, and mix these with 80 oz. of water for the developing bath.

As a restrainer, which is used only in cases of

over-exposure, the following formula may be used:

Bromide of Potassium.....	1 oz.
Water.....	6 oz.

After development, the film should be rinsed and then placed in the fixing solution. The usual fixing solution comprises:

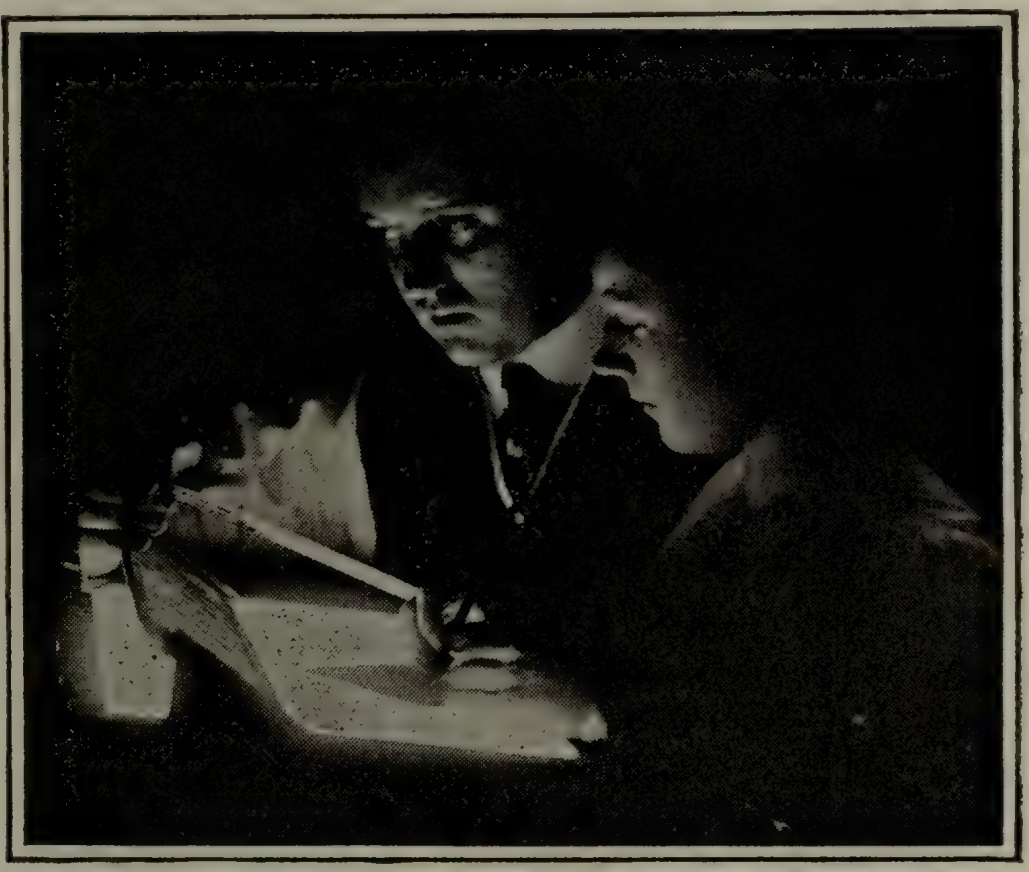
Hyposulphite of Soda.....	24 oz.
Water.....	96 oz.

The important part in development is to maintain the temperature of all baths as near as possible to 65 deg. Fahrenheit. In summer ice should be added if necessary to bring the developing and fixing baths down to that temperature, while in winter the solutions should be slightly heated to raise them to that temperature. Temperatures lower than 65 deg. cause the developer to act too slowly, while higher temperatures cause too rapid development and also may lead to the fraying of the film, that is, the peeling of the emulsion from the celluloid base.

As for the positive film, on which the prints are made, there are various kinds of stock that may be used. Eastman is, to be sure, the standard in this country and in many others. However, there are other positive stocks made in this country, such as Powers and Bay State films. Of foreign films, there are Pathé, Gevaert, Agfa, and others. In the case of positive stock there is little risk in experimenting with various brands, and in this respect it is quite a different matter from negative stock, where the chances taken on some unknown stock

Washing tanks in which the developed negative and positive films, still on the racks, are thoroughly washed of all traces of hypo. The washing operation must be thorough if the films are to be clean and permament, and vast quantities of water must be used in such work.

may be serious and costly if unsatisfactory results are obtained. The author has employed various kinds of positive raw stocks, and finds several of them most satisfactory. The Gevaert positive stock can be obtained with a tinted celluloid base; that



The "timer" of the usual laboratory determines the density of the negatives and decides on the lamp adjustments for the printers.

is to say, the color is in the base itself. Thus for fire scenes, red celluloid positive can be purchased, and so on. The Eastman Kodak Company also offers colored positive raw stock. This eliminates the necessity of tinting films when making positive prints on a large scale.

After the positive stock has been decided upon, it

is passed through the printer face to face with the negative film as already described. Most large laboratories have an experienced man who can tell at a glance how much exposure to give each scene. Obviously, as a negative changes in density from one scene to the next, the printing time, as it is erroneously called, must be changed. In reality it is not the time that is changed but the strength of the printing light, more light being employed to print through a dense film, and less light through a weak negative. The "timer," as this expert is called, decides on the printing adjustment for each roll of negative, and the girl operators tending to the printing machines have but to set the printing lamps so many "points" for each scene in order to obtain the proper results.

After being printed, the positive rolls are sent to the darkroom, where they are developed very much after the fashion of the negatives, except that different solutions are employed. A positive developing solution which gives good results is as follows:

No. 1

Oxalate of Potash.....	10 pounds
Hot Water	30 pints
Acidify with Sulphuric or Citric Acid.	
Test with Litmus Paper.	

No. 2

Proto-Sulphate of Iron.....	2 pounds
Hot Water	3 pints
Sulphuric Acid	1 dr.
Or Citric Acid	½ oz.

No. 3

Bromide of Potassium.....	1 oz.
Water	1 quart

To develop with this formula, Nos. 1 and 2 are poured and 5 drams of No. 3 are added. They should be mixed in the order given. The developer should be allowed to act until sufficient density is obtained in the shadows; then the film is rinsed and fixed. If there is a tendency to frill, a saturated solution of common alum should be added. Less of the No. 2 solution will give less violent contrasts.

The Pathé organization suggests the following formula to be used with Pathé positive stock:

FORMULA FOR ONE U. S. GALLON

Water	1 U. S. gallon
Metol or Rhodol.....	58 grs.
Hydroquinone	1 oz. 102 grs.
Soda Sulphite (anhydrous).	4 ozs. 409 grs.
Soda Carbonate (anhydrous)	9 ozs. 332 grs.
Citric Acid	82 grs.
Metabisulphite	175 grs.

For use take one part of stock solution and one part of water.

The fixing solution, suggested by the same film manufacturers, is as follows:

FORMULA FOR ONE U. S. GALLON

Water	1 gallon
Soda Hyposulphite	30 ozs. 158 grs.
Soda Bisulphite	4 ozs. 409 grs.

The practice is for each manufacturer of raw stock to issue complete directions covering the development of positive and negative films. Generally slips of paper, containing development and fixing formulæ, are contained in the film cans.

But as was stated earlier in this chapter, the average amateur is pretty far afield when he endeavors to do his own laboratory work. It should only be undertaken as a last resort.

This must not be understood to mean that the amateur should not know something about laboratory work. In fact, he should know more or less the general details of such work so that he can meet the laboratory men and talk to them with some degree of intelligence, in order that they will take special care of his work. Furthermore, the amateur should know whether any given faults in the films delivered to him are due to his errors or those of the laboratory. Hence the following notes must prove of interest in the way of checking up on the laboratory:

Negative Troubles and Their Causes

Most negative troubles start with the exposure. If the exposure is at fault, then it is hardly fair to expect good results in the development of the negative and the subsequent print; for, despite all popular belief to the contrary, darkroom methods cannot correct exposure mistakes to any marked extent.

A correct exposure can always be identified with little difficulty. It produces a well balanced image in which the detail in the shadows is clearly presented without over-development in the high lights.

If a picture is over-exposed, on the other hand, there is a lack of contrast. If the development is carried past the safe point the shadows and half-tones become black and fill up, so to speak. The whole image becomes clogged up, and it is so dense that the negative is difficult to print from. Such prints as are obtained are certain to be flat and lack brilliancy, since there were no true transparencies and near transparencies in the negative. An under-exposed negative reveals itself by the fact that there is no detail in the shadows, and if the development is carried beyond the safe point, in order to bring out something in the shadows and half-tones, the high lights fill up or become chalky. The resultant print is harsh and does not possess the soft gradations to be found in a properly exposed picture.

Most laboratories, when they discover a negative too much under-exposed or to much over-exposed, advise the cameraman to that effect and suggest his making a new negative. Of course, human nature is such that a request of this kind is often not heeded, and the laboratory men are told to go ahead with the negative as it stands. This they can do, but the screen results can never be of the best. The capable laboratory man can do something to help along the under-exposed or over-exposed negative, but in the long run there is nothing much to do that can offset faulty exposure.

If the negative film appears gray all over, where it should be clear and perfectly transparent, it indicates that it has been fogged or light struck. Such trouble may come out of carelessness in loading the

Printing room of a typical laboratory. The girl operators work in semi-darkness, the necessary illumination being supplied by rather bright ruby and orange lamps. Positive film stock is far less sensitive to light than negative stock.

magazines, and in taking chances with an unsafe ruby light. Again, it may be due to the use of old negative film. Negative film, unlike positive, has a rather limited life, and even though it is kept in hermetically sealed tin cans it does fog from deterioration after a given time. All reliable film dealers sell only fresh film, and the buyer need never worry about fogged or aged film.

Another cause for fog is the camera lens. If the lens is dirty or covered with a hardly perceptible layer of dust or even oil, it may produce a foggy image. Camera lenses should be carefully cleaned at frequent intervals, as explained in the chapter dealing with camera work.

Fog may also be caused by the handling of the film in the laboratory. While most laboratories of reputation are careful in the extreme, film is sometimes fogged accidentally. Furthermore, fog can develop as the result of too much alkali in the developer or too warm a solution.

Halation is a film fault that is occasionally noted in even careful work. It takes the form of sharp splashes of light about certain objects, making a most unpleasant spot on the picture. It occurs usually in interior pictures taken towards bright windows, when dark objects are photographed against the sky, or when white objects are photographed against dark backgrounds. Halation is due to excessive light at one point with reference to the light reflected by the rest of the scene. It can also occur through reflections inside the camera, such as when the lens hood or other piece of equipment is not

properly blackened, and a ray of the sun happens to illuminate that bright spot at an unfortunate angle.

The exposure of the negative is not always the whole cause for the blame. Sometimes the negative is under-developed, in which case a thin and weak negative results, without sufficient density and detail for making a good print. Such under-development may be due to carelessness in timing or in judging the progress of the development, and in using developer of too low a temperature. Again, it may be due to the exhaustion of the developer. In rare instances the fault may be laid to the cameraman, who has used such excessive diffusion in his lighting that there are no shadows of any kind to relieve the picture.

A very rare trouble in the better film laboratories is the frilling and softening of the film emulsion. This trouble usually occurs only when the developer and other baths are of too high a temperature. Sometimes this may cause the emulsion actually to slide off the film base. Violent changes in temperature are also liable to cause frilling. An old hypo bath may also cause frilling and softening, since the object of the hypo bath is also to harden the emulsion. The emulsion sometimes softens if the drying is carried on in too warm a room. But as a general thing frilling and softening are only troublesome features in warm climates, and may be readily avoided with ordinary care.

Occasionally stains are to be found in negative after development, due to careless handling. Brown

and yellow stains are generally due to incomplete fixing or the lack of thorough washing after fixing. Decomposed fixing bath or oxidized pyro developer may also cause stains. Yellow stains along the edges of the negative are due to the same general causes. Purple spots may be due to decomposed pyro or other chemical impurities in the rinsing water.

Tiny transparent spots on the negative may be due to drops of oil that have been deposited on the film prior to development, thus keeping the developer away from the emulsion at that point and preventing development, or to improper shaking of the rack during development, thus allowing air bells to form and remain in place.

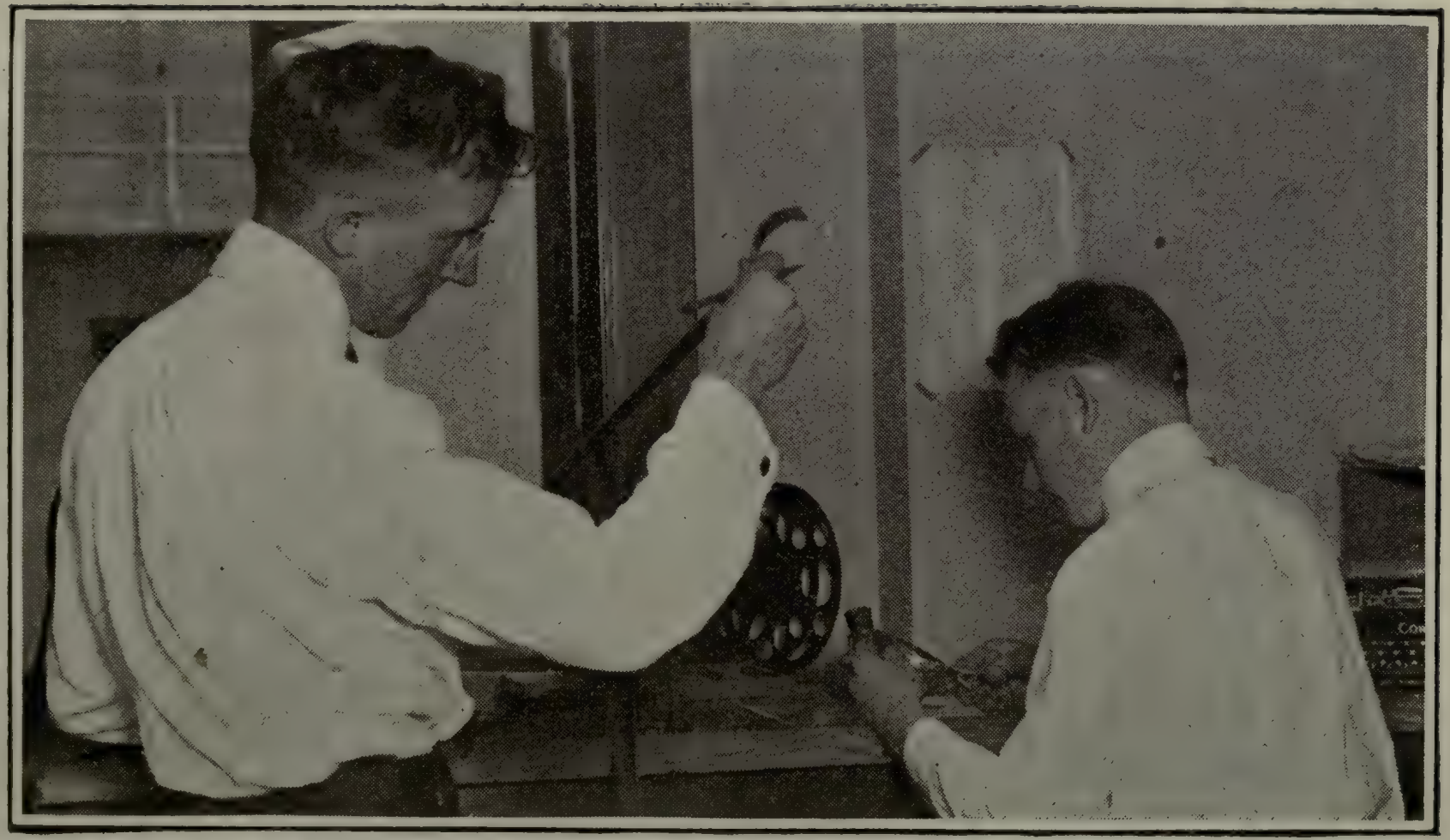
Finger marks on the film indicate careless handling. Dirt and other marks also indicate careless handling.

The same faults may be found in positive prints, although much of the trouble in positives goes back to the negative, for without a good negative to work from the positive can hardly be expected to be good.

Adding Color to the Pictures—Tinting

Whatever may be the difficulties in obtaining good photography and laboratory work, the matter of coloring films is a relatively easy one and its results are immediate; so that one can, under ordinary conditions, observe the effects of one's labors in full daylight and, like the chameleon, keep on changing colors at will.

Leaving aside free-hand coloring or coloring applied by means of stencils, either of which is not



The final step in laboratory operations is to edit the film. The various bits of films must be assembled one by one in accordance with the final scenario, and the surplus action and unnecessary scenes eliminated.

practical for the layman, we will speak only of the two current methods of applying color to films as they are practiced in the usual motion picture laboratory.

The simplest method of coloring in general use is called *tinting*, and generally consists of dipping a finished film in a tank containing a solution of aniline dye and leaving said film submerged until it has absorbed the necessary amount of color. There is no reason to fear that the film will be ruined by too much or not enough tinting, as the aniline dyes used for motion picture work are all water soluble. Indeed, if the tinted film should turn out unsatisfactorily as far as the tint intensity is concerned, not matching another piece of film or failing to produce a certain desired effect, it is a simple matter to place the film back into the tank and wait until the correct amount of color has been incorporated. Should there, perchance, be too much color, it can readily be washed out by soaking the film in plain cold water.

To avoid mysterious formulæ which are bound to complicate matters for and discourage the beginner, it will suffice to know that it is by far easier, cheaper and certainly better not to try to mix a variety of dyes together in order to obtain certain shades. There are aniline powders (water soluble) known as orange, amber, yellow, red, salmon, green, blue, etc., which, when highly concentrated, can be diluted at the rate of about one-half of one per cent. of powder to one hundred volumes of water; in other words, to one gram of dye one can add two hundred cubic

centimeters or grams of water. Large quantities can be mixed by observing the same proportions and increasing to any desired amount. To mix the dye, it is preferable to use hot water, not necessarily boiling, and to stir the solution with a wooden stick or glass rod, and then pass the solution through a thin piece of lintless fabric, such as an old handkerchief. The dye solution must be cooled off before using.

Before attempting to color a length of film, one must always make sure that it has been fully washed and freed of all traces of hypo.

Any amateur motion picture worker who is sufficiently interested in the tinting of film will get a great deal of enjoyment out of his first experiment, provided he goes about it in the right way. All films take on new interest when they are tinted; and a far more interesting picture can be produced by proper tinting.

Any old piece of film will do for a test. Take, for instance, ten feet of film and wind it on a simple rack. The rack is then placed in running water for about ten minutes and then removed and dipped directly in the color tank From time to time the film is examined to study the extent of the tinting, and once the desired degree of color is obtained, the film rack is removed and rinsed by dipping it three to five times in running water. It is then dried.

Toning the Film Images

Toning is a somewhat more complicated method of coloring film, because mistakes are not as easily

corrected as in tinting, and accidents and failures are more numerous. Besides, the toning solutions are more costly because they are subject to deterioration by exposure to air and light, and also become consumed much faster than aniline dyes. Before toning, films must be washed for at least one hour, then treated according to the formula answering the specific purpose or color required.

The following indications will enable any careful person to obtain a wide range of shades, especially when tinting is combined with the toning operations. It must not be forgotten that *toning* modifies only the shadows and half-tones, while the *tinting* affects the high lights. In this manner, if a piece of film is *toned* blue, the blacks and half-tones will take on a varying degree of blue, while the high lights will remain white or clear. Thus the picture becomes blue and white, the black giving way to blue. But if that same picture had been *tinted* instead of toned, then the entire picture would take on a blue tint although the blacks would remain superimposed on the blue. The picture then becomes blue and black, instead of white and black. Toning gives prettier effects than tinting, to be sure.

One of the most popular tones is sepia. An excellent method for producing a warm sepia tone consists of preparing two solutions as follows:

SOLUTION A

Ammonium Bromide	5 grams
Potassium Ferricyanide	15 grams
Water	300 c.c.

Cementing and assembling operations in a large laboratory. Girl operators, especially trained in this kind of work, are employed because of their dexterity. Cementing calls for skill and care to ensure clean and strong joints in the film.

SOLUTION B

Sodium Sulphide	10 grams
Water (pure)	300 c.c.

As soon as the film has been washed for about an hour or more, it is placed in Solution A, where it is left until the image is bleached out; that is, when the image is a creamy white, without any dark spots. Then the film must be washed in clean, cold water for about one minute. After washing the film is placed in Solution B until it has acquired a warm brown tone. Then it is rinsed and dried.

Some amateurs, particularly those who do not maintain a fully equipped darkroom, and accordingly are forced to do their work at home, will find the above toning solution difficult to employ for the reason that sodium sulphide has a rather objectionable odor. So when sodium sulphide is objected to, the best substitute is the uranium nitrate brown toning, which is prepared as following:

Uranium Nitrate.....	40 grams
Potash Oxolate (neutral).....	40 grams
Potassium Ferricyanide.....	16 grams
Hydrochloric Acid 10 per cent. solution	40 c.c.

Numerous formulæ have been recommended for blue tones, but in truth they are all more or less too complicated for the amateur. The simplest of any of them will give the average layman fair results, provided he is careful in compounding the chemicals

and in washing the film before toning. The formula for blue toning is as follows:

Water	300 c.c.
Citric Acid	150 grams
Potassium Ferricyanide	30 grams
Ammonium Alum	96 grams
Iron and Ammonium Citrate	30 grams

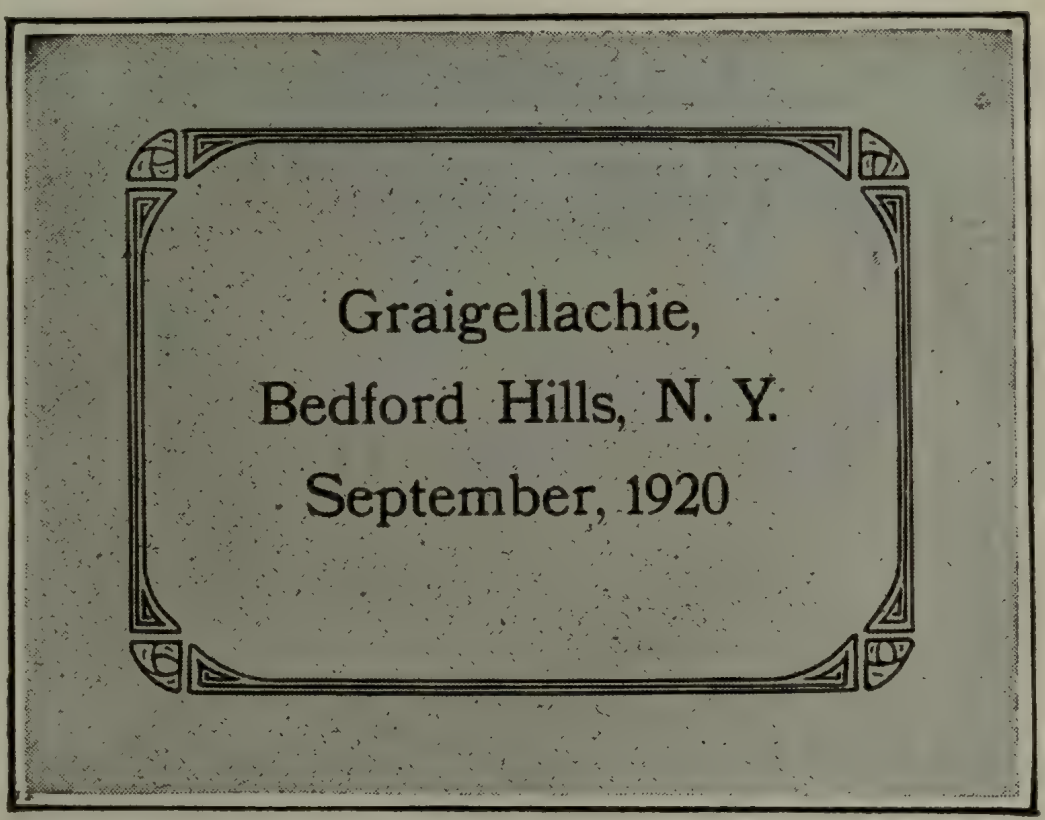
Now, with a brown and a blue tone one can obtain almost any color with the proper combination of toning and tinting. Take, for instance, a blue toned film and dip it in a pink solution of aniline dye, and a surprising result is obtained, particularly if there are any clouds in the scenes. Green grass and trees will look almost natural when the film is first toned blue and then tinted amber. Blue toned films being of a different shade than the color which is obtained with aniline blue, a film sometimes shows up better when tinted blue after it has been toned in a blue toning solution.

Examples can be multiplied, but the tinting and toning angle is one which must be left to the individual taste of the user, for, as the French proverb has it, "One does not discuss tastes and colors." At any rate, all first-class laboratories are prepared to tint and tone films at a slight cost.

Cementing Short Lengths Into Reels

With the positive films printed up, and colored if desired, a very necessary operation in the preparation of motion picture films is the editing and cutting. The various bits of films are carefully examined so

as to make certain that the photography is satisfactory, the action comprehensive, and that the footage is of the proper length. All superfluous footage can be eliminated. The various bits of film, following this cutting, are assembled into one long strip by means of a cementing outfit. Full details regarding

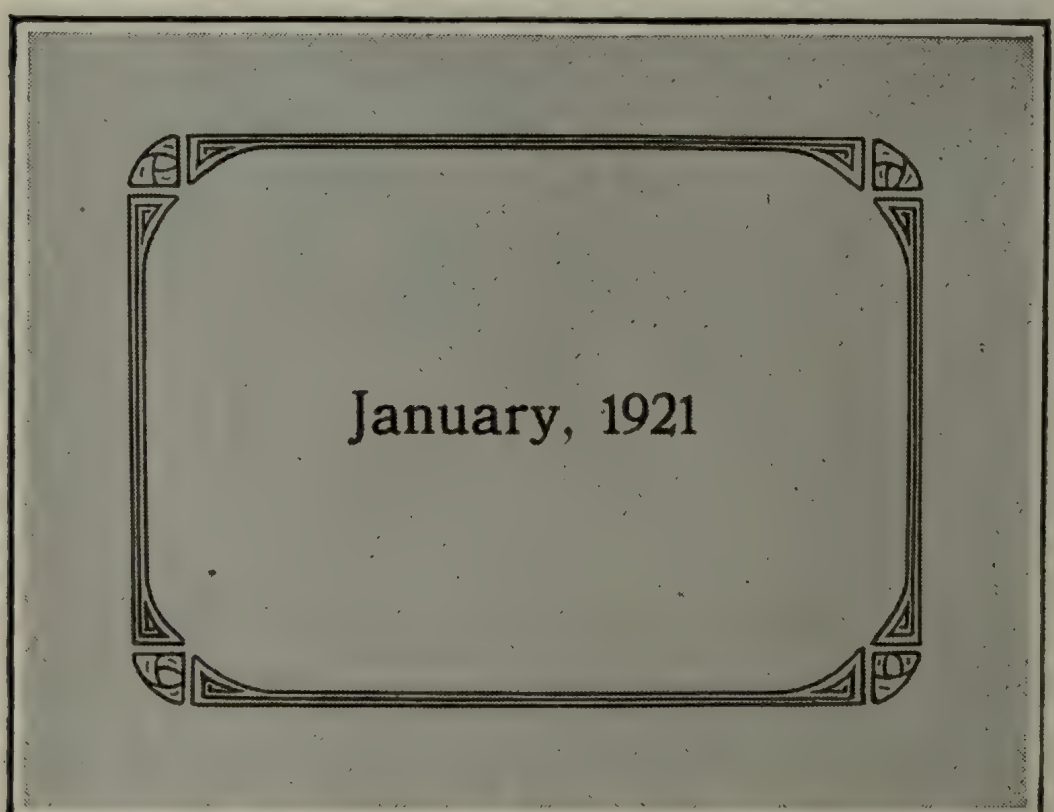


Typical title card for the main title of a family film. This card measures 8 by 10 inches in the original.

this phase of motion picture work are given on page 287, since projector operators must often make splices in damaged reels of film.

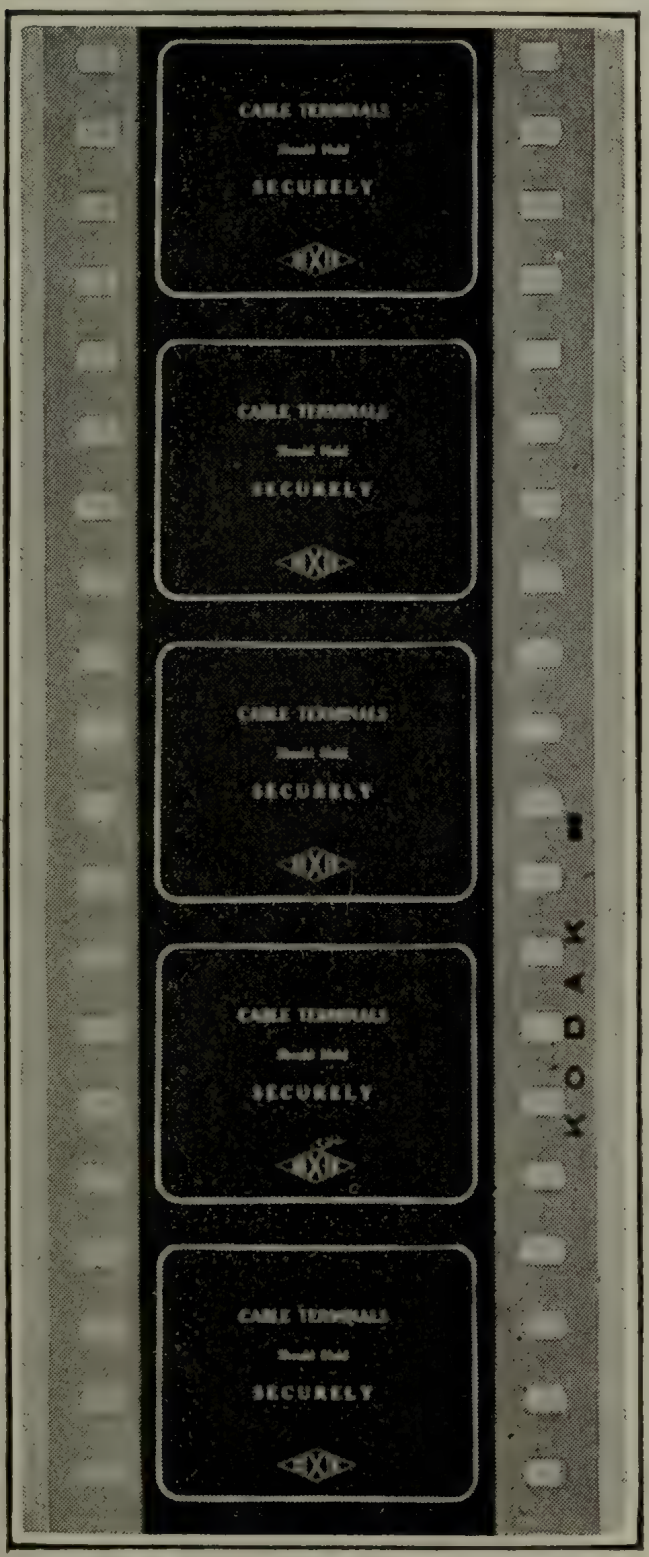
Another phase of motion picture production is title making. The camera can be used for making titles if desired, although it is best to use some form of

title machine. When using the ordinary camera, the titles are either hand-lettered or printed on white paper and placed some distance away from the camera so that the title just fills the aperture of the camera when viewed through the peephole. There are two ways of making these titles, namely, to



Typical title card for sub-title of a faimly film, If desired, the border may be dropped in sub-titles.

photograph black lettering on a white background, in which case the film taken out of the camera is ready for projection purposes following development, since it has white lettering on a black background, which is the ideal arrangement for standard-sized film titles. This method is known as making titles



Strip of title film of an industrial film.

in camera, and eliminates the necessity of a negative, which is quite costly, and certainly useless where only a few feet of title are required for one positive print of the picture. The other method is to use white lettering on a black background, and then photograph the title to obtain a negative film. From the negative any number of prints can be made.

With a makeshift arrangement for photographing titles, the amateur cinematographer should endeavor to make his title copy as large as possible so that through the reduction he will obtain a sharp

image on the film. Larger copy, too, means that the camera can be placed further away, and that leaves much more room for manipulating the apparatus.

For really good results the camera should be mounted on a stand somewhat similar to the animating stand described in Chapter XIV. The copy for the titles can be placed on the table of such a stand, and the camera operated from overhead. Besides, trick titles can be made with such an arrangement, using cut-out letters on either a white or black background, as the case may be. The letters can be moved about by hand and the exposures made one at a time with the camera, so as to obtain trick titles.

Sample title copies are shown on pages 237 and 238, reduced, of course, since the originals measured 8x10 inches. These titles appear in the reverse effect on the screen—white letters on a black background. It is best to leave the matter of titles to a laboratory, since this work really requires laboratory equipment for proper results. The copy for titles should be given to the laboratory in typewritten form, so as to avoid all chances of misspelled names and words. With the delivery of the finished titles to the amateur cinematographer, he should see to it that he also receives the title copy or "cards," since the same cards can be used as many times as may be desired, and it avoids an extra expense if old cards are kept whenever there is a chance of their being of some future use.

In preparing titles it is well to bear in mind that the number of words is very much limited. A long title is one with 50 words, and where skill comes

Animated doll films require day after day of tedious work to produce, being trick motion work. With such subjects it is well to make a test development of a few feet to check up on the exposure before going ahead with the camera work.

in is to express a given thought in the least number of words. The amateur will be surprised to find how many superfluous words are used in everyday descriptive matter for expressing thoughts. So in many titles the original typewritten copy should be gone over a number of times until the words have been reduced to the irreducible minimum. As for footage on titles, the author finds that it is well to have one running foot to every two words, especially in amateur projection, where the film is often sent through the machine at a higher rate than the usual 65 feet per minute.

Positive film should be placed on a reel so as to be ready for the projector. If the film is to be added to other film, then it can be cemented in the usual way. The reel of film should always be kept in the tin can, whether it is of celluloid or non-inflammable stock, for safe keeping.

As for negative, it is simply wound in a roll, wrapped up in tissue paper and placed in one of the usual film cans in which negative and positive stock come from the manufacturer. Most laboratories maintain a special film vault for the benefit of their customers and store their films for little if any fee.

Chapter VI.

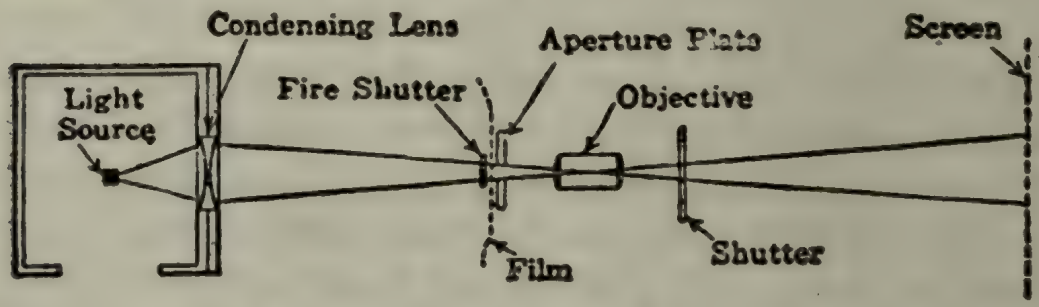
PROJECTORS FOR PROFESSIONAL OR AMATEUR USE

PROJECTORS fall into two general classes, those using standard celluloid professional film and those using safety film of the non-professional sizes. In the present chapter we are only concerned with the first class, making use of standard sized or professional film, since the Safety Standard and other non-professional film projectors are covered at length in Chapter XIII. of this work.

Analyzing the standard sized film projectors, we find that the class divides itself quite nicely into three sub-divisions, for the convenience of this treatment. First, there is the standard type of projector for strictly professional use, such as is used in our theatres both large and small. Secondly, there is the semi-professional projector, which is a compromise between the standard theatrical machine and the amateur and portable types. Usually projectors of this type are miniature copies of theatrical projectors, with such modifications as go to simplify the mechanism for the convenience of the amateur operator. Thirdly, there is the portable projector, generally made in the form of a suit-case for the sake of portability, and quite adaptable to the needs of the amateur who desires to project standard sized films.

Portable Projectors of the Suit-Case Type

We had best start our survey of projectors with the portable or suit-case types, for the reason that these will be found best for the needs of the average amateur who desires to project standard sized film.



Elements of a professional projector employing an arc lamp. Compare this with the simple arrangement for the incandescent lamp type, shown on the following page.

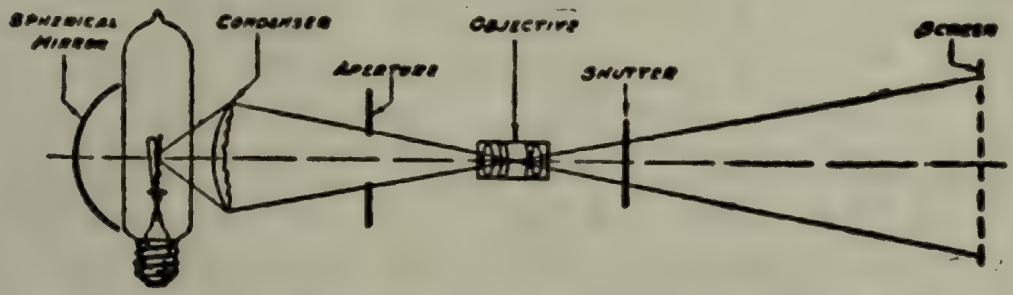
Again, this style is well suited for non-theatrical projection in general, such as for salesmen, traveling shows, welfare and factory work, schools, churches, and so on. Professionally, too, this type comes in for consideration, since there are several uses for it in everyday film activities, such as the review of films by the theatre manager, the projection of reels that are being edited, and other similar purposes where it is not desirable to employ a standard projector.

Today there are quite a number of excellent portable projectors of the suit-case type, so that the prospective buyer need not be at a loss for want of variety. Basically, all the offerings follow the same general idea, with incandescent lamps as the source of illumination, an electric motor for the drive, some

form or other of safety device to prevent film fires, proper controls for the rate of projection, rock-steady mechanism, and an asbestos-lined or otherwise fire-proofed carrying case which encloses more or less the entire equipment. In other words, the projector is enclosed in its own fire-proof booth, so to speak.

To attempt to describe all the offerings would be impossible in the limited space at our disposal, but in a spirit of impartiality and a desire to point out certain striking features of some of the machines, we touch upon the better known ones. It must be remembered that others, not mentioned in detail, are none the less worthy of attention, duplicating in many cases the features here mentioned.

One of the oldest of the portable projectors is the DeVry, weighing 20 pounds. The mechanism head of this projector is made of cold-rolled steel which



Elements of an amateur projector employing an incandescent lamp. The arc lamp is being replaced by the incandescent lamp in professional projectors of limited throw.

assures the greatest possible tensile strength. The sprockets, as well as the automatically locking idlers, are from solid bars of tool steel. It is well to mention these features since they indicate that just as

much care is required in the construction of these portable projectors as in the standard theatrical projectors, if proper screen results are to be obtained.

The DeVry intermittent mechanism, which moves the film at the standard rate of sixteen pictures per second, when operating at normal speed, is of the standard Geneva star and cam type, which is an eccentric mechanism where the star makes one complete revolution to every four of the cam.

In a projector designed for non-professional use, it is as essential to include helpful devices as to eliminate all superfluous non-essentials. For this reason it will be found that the DeVry, which is typical of several other portable projectors, contains only those devices that are essential to projection, and nothing more. Thus there is no stereopticon attachment, for the reason that such additional equipment does not make for an efficient arrangement.

The DeVry has neither film magazines nor fire rollers, in which particular it differs from most other portable projectors, some of which are described further on. The designer of the DeVry claims that in only some 40 per cent. of the time these devices are effective or can be depended upon to snuff out a flame after a fire is started. This, of course, is a controversial matter which the author, after presenting the arguments put forward by other designers later on, prefers to leave with the reader for his decision.

The DeVry designer states that in recent tests before State fire officials it was proved impossible for the DeVry projector to ignite the film, even when

the automatic fire shutter was removed. When the light was permitted to ignite the film, only one frame of the reel could be burned. The snuffers on the film shoe, as well as a snuffer tube and the additional fire guard with which the projector is provided, prevent a spreading of ignition beyond the source. Guards that prevent the film from coming in contact with any place that permits of any possible chance of fire, are also provided on the DeVry machine.

In these tests, so the author is told, a thousand-foot reel of inflammable film was ignited with a match inside of the DeVry, and the door closed. The film smoldered, but at no time did open flame appear on the outside of the projector case. During these tests the DeVry was picked up and carried about while the film was burning within the case, as there are many who incorrectly believe that films are explosive. Films by themselves are not explosive. Under certain conditions, where the film has been ignited but is decomposing rather than burning with a flame, in a closed space, it generates certain gases which, when mixed with air, may prove explosive. But films, *per se*, are not explosive, nor are they spontaneously combustible.

The case of the DeVry projector thus affords excellent protection. One of the latest additions is that of another "view opening" or "porthole" in the door of the projector case. The original opening has been moved over to take in more specifically the feed and take-up sprockets, as well as the lower loop, so that they can be readily seen from any angle. The new

opening is at the side of the feed reel, so that the amount of the film on the reel can at all times be instantly known. That is a decided advantage, as becomes immediately obvious to anyone giving it due consideration. The operator is enabled to know the conditions inside the projector during actual projection without opening the case.

As in all present-day portable projectors, the DeVry makes use of a high-power incandescent lamp, combined with a highly efficient optical system. So simple is this optical unit that only one adjustment, focusing, is necessary, regardless of the size of the picture or length of throw. The adjustment of focusing is accomplished by simply turning the focusing button attached to the exterior of the projector case. The standard equipment of the DeVry projector is a lens of 4-inch focus, although on account of the construction it is possible to use a 6-inch lens to project a 12 by 9 foot picture at a distance of eighty feet from the screen Smaller pictures are projected at a shorter distance from the screen.

A Power Plant for the Portable Projector

The DeVry generator unit is a little device which may be attached to any automobile, generally the Ford car, enabling anyone to produce current to operate the motion picture projector as well as to light the building or the grounds with a string of lights, operate the stereopticon, or to operate any 30-35 volt electrically-driven device. Obviously, the projector employed in conjunction with such a power

plant must be made for that voltage, and not for the standard lighting circuit voltage.

The DeVry portable generator, so it is claimed, gives the itinerant projectionist city conveniences and makes him independent of any outside assistance in his exhibition. The outfit is more or less indispensable to the exhibitor in small-town theatres, rural circuits, propaganda work—health, political, Americanization, etc., for Chautauquas, tent shows, open air shows, summer resorts, community work, large pastorates, consolidated schools, etc. The complete outfit is readily installed in one and one-half hours' time and requires no mechnical experience either in installation or operation. The voltage is controlled with panel box at the projector, and is so simple to handle that a youngster can operate it as easily as a veteran, so it is claimed. The generator is so mounted on the engine frame that it can be driven by a special gear on the engine shaft and a chain transmission, while the car is at rest.

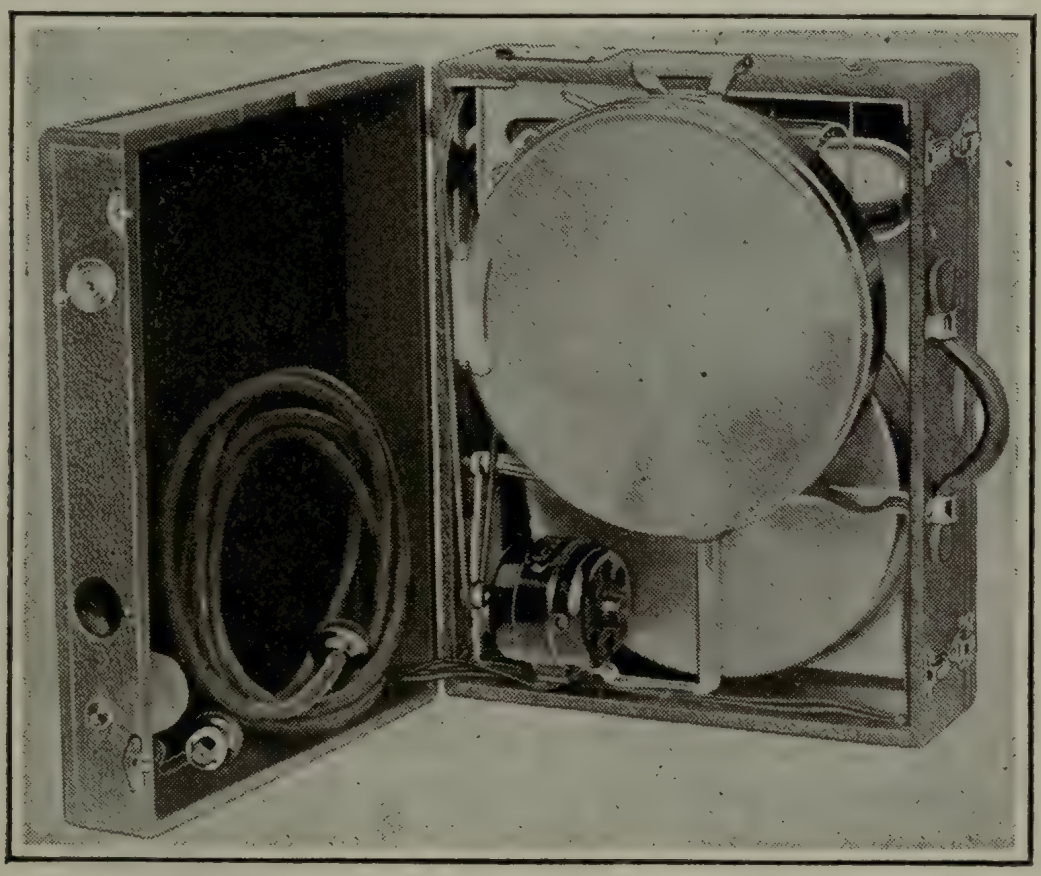
Another portable projector, which is of about the same general appearance and weight as the DeVry projector, is the Transatlantic portable projector. It is claimed to be fire-proof, flickerless, compact, noiseless and portable. It is operated by electric motor, with all its gears running in oil. Like the DeVry and most other portable projectors, this machine gives a clear, sharp image at distances of from 20 to 90 feet, with rock-steady results. No useless parts are incorporated in its construction to confuse the operator.

The novel feature of the Transatlantic projector,

which distinguishes it from most other portable projectors, is the device that makes it possible to stop the film at any point, so as to have "still" projection of any desired frame. Thus it is said to combine the advantages of the stereopticon with those of the motion picture machine. This feature is brought about, in complete safety, by having an ingenious system of water circulation for the condenser apparatus. The light, passing through the water-cooled condenser, is freed of much of its heat by the water, which is kept in circulation through the pipes and a little reservoir above by the thermo-siphon method. It is claimed for this projector that film has been left in it all night long, at rest, with the light full on, yet without a fire, indicating that the automatic water circulating device provides ample cooling for the powerful rays of the lamp. Besides, the case is lined with asbestos to provide further protection from fire. The various controls are on the front of the case, operable from outside, while the machine is in operation.

Still another portable projector is the National Projector, also of the suit-case type, which possesses certain radical differences that distinguish it from others of this class. To begin with, it has a dual lighting system, which is controlled by lugs in the governer, so that when the machine is operated these lugs connect by centrifugal force, making contact that steps up the light automatically. When the machine is stopped, these lugs drop and cut down the light to one ampere, which gives a safe light on the picture with no danger of burning or blistering

the film. Another novel feature is a unique framing device, which frames the whole mechanism head of the machine, allowing the film to remain in mesh with the intermittent and feed sprocket. In this



This projector, the Aladdin, has the top magazine folded down into the case for the sake of portability.

manner the picture can be framed while the machine is in motion or stationary.

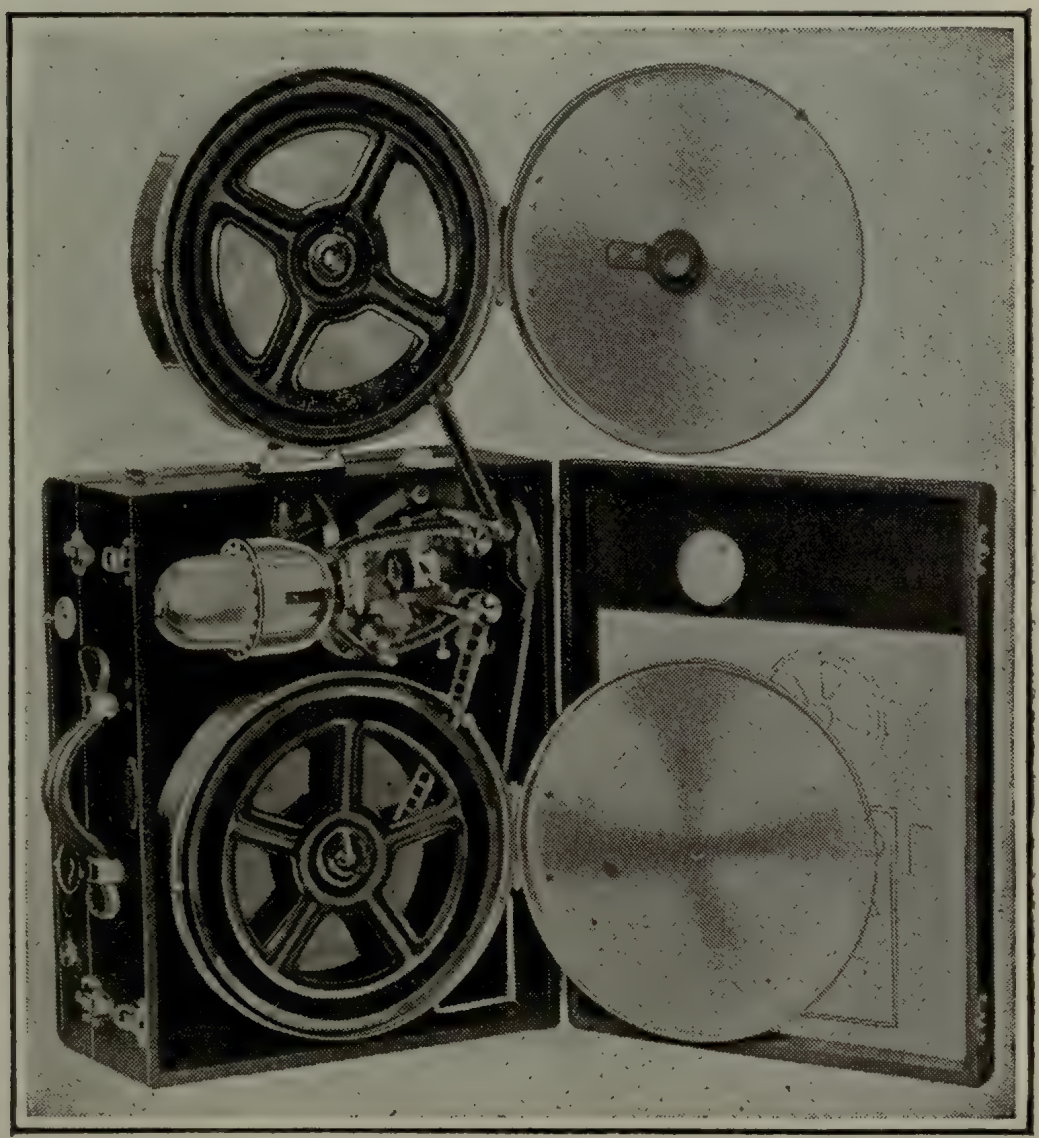
Again, the National projector drives its intermittent sprockets and the reels by one single silent chain. All extra belts and gear trains have been eliminated in this projector. Another feature of this machine is that all units for projection purposes

are assembled on a cast frame, making one solid unit; and when the machine is completed it is then fastened into the carrying case by two hinges, which construction permits it to be swung out of the machine, independent of the case, for threading up and inspection of the mechanism. So in this form of construction there is ready access to all parts, and the operator is not obliged to work in cramped quarters.

The controls of the National projector are only exposed when the machine is in operation, being at all times housed in the rheostat compartment at the top of the case. These controls comprise all connections of, namely, lighting system, reversible motor switch, and rheostat motor speed control. The speed of this machine is controlled by the simple turning of the rheostat motor control to a faster or slower speed as the operator may desire. The light, as already stated, is automatically controlled by the speed of the motor. The machine may be operated backwards as well as forwards, thus giving ample opportunity for trick effects. The film reels are enclosed in metal magazines and placed side by side.

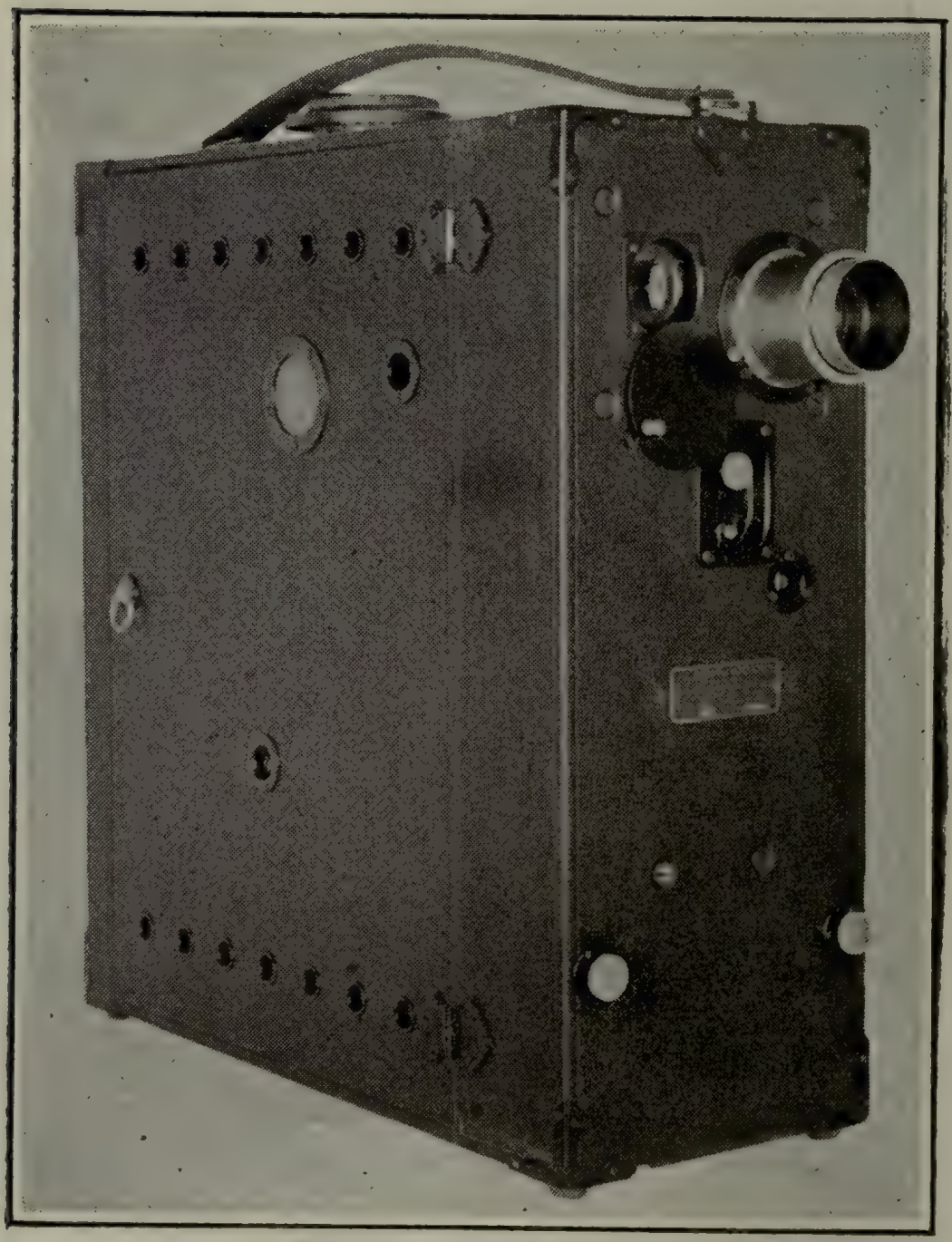
Then we come to the Aladdin Projector, which is also of the suit-case type. Here the claim to originality is most strongly exemplified by the arrangement of the reels when set up, which, instead of being placed side by side as in the usual portable projector, has one reel above and outside the case, and the other one inside and in the lower half of the case. It is true that this arrangement makes the passage of the film through the mechanism

considerably simpler than the side-by-side arrangement, which calls for two sharp twists, as a rule.



The Aladdin projector, which is shown closed on page 251, opened up and ready for action. The reel placed above the case provides a simpler path for the film.

The upper or outside magazine of the Aladdin is so arranged that when the machine is being carried it is folded down into the case. Otherwise the pro-



The American Projectoscope, which throws a picture with clearness and rock-steady results up to 60 feet away. The various controls for the mechanism are placed outside the case so that they may be available during projection.

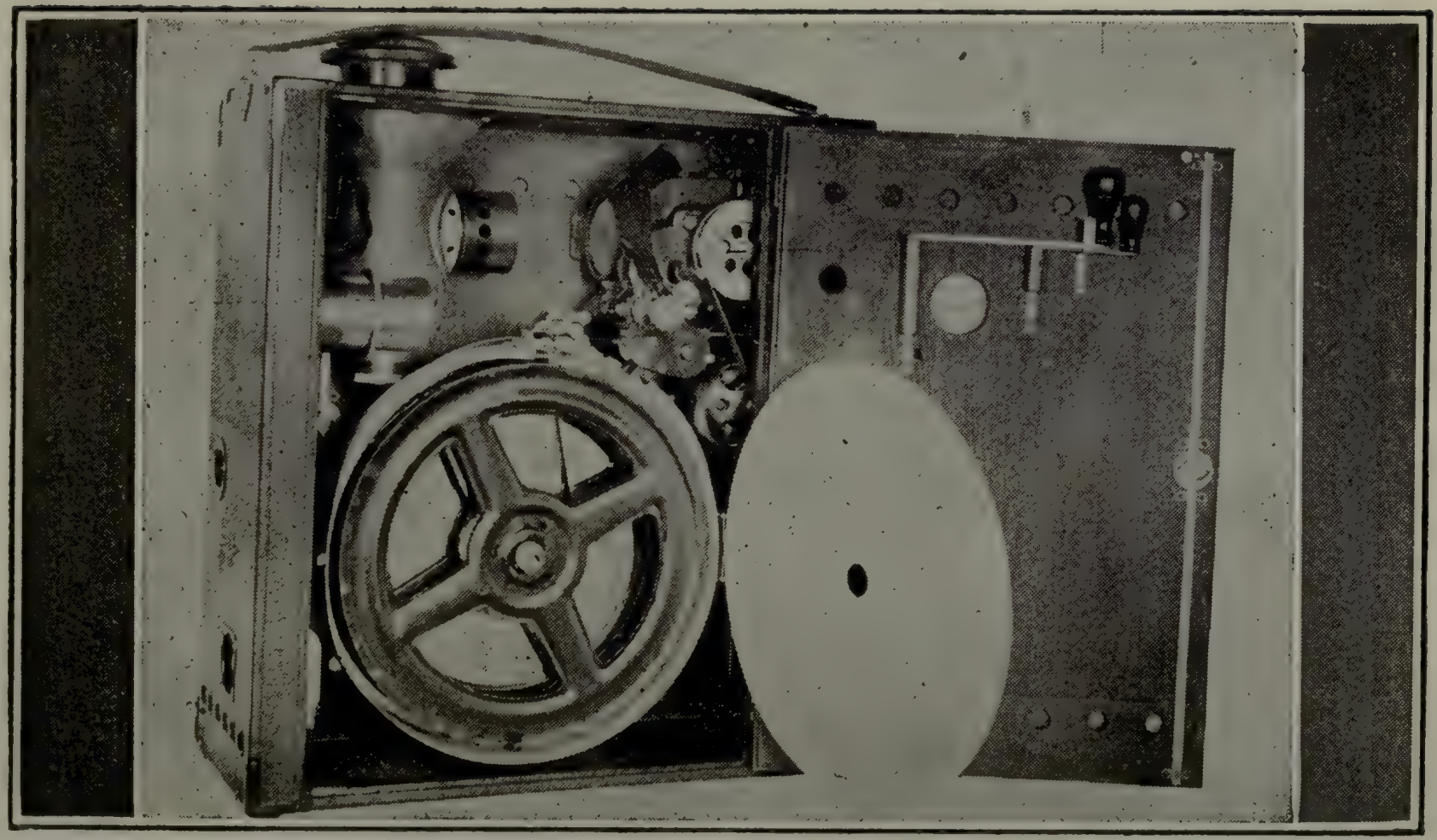
jector follows more or less the accepted standard practices, such as incandescent lamp, motor drive, external controls, and suit-case assembly. The film is contained in metal magazines.

Then there is the American Projectoscope, which is a portable machine of the suit-case type weighing 25 pounds. Like the other projectors of this general class, it draws current from any electric light socket, either alternating or direct current. It can be operated forwards or backwards. This machine will throw a picture at from 6 feet to 80 feet with clearness and rock-steady results. It can be operated either by motor or by hand.

The mechanism head of the American Projectoscope, which contains the motor, motor base, patented reversible snap switch, shutter, driving gears, star and cam, sprockets, framing mechanism, aperture. reel drive pulley and flywheel, is the most important part of the assembly. The motor is of the universal high-speed reversible type, while the patented reversible motor switch is simplicity itself, giving universal control from one key. Needless to say, the workmanship is of the finest in order to ensure excellent screen results.

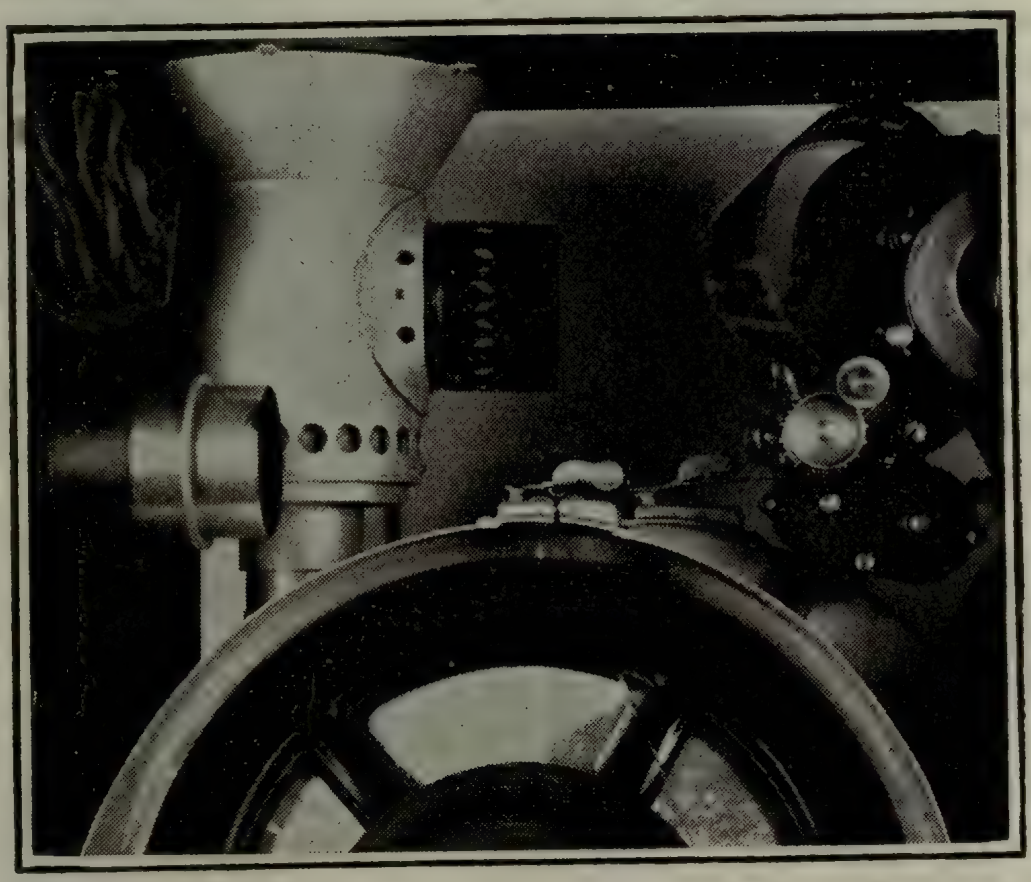
The framing device is built into the intermittent sprocket of the machine. This framing device gives control of one-twentieth of an inch to each picture.

The American Projectoscope is different from most projectors in that the shutter is mounted between the aperture and the projecting lens for protection, which construction also adds to the compactness of the mechanism. The aperture tube is



The American Projectoscope opened, showing the lamp, mechanism, driving motor, and film magazines. The shutter of this machine is mounted between the aperture and the projecting lens, which construction makes for compactness.

lined with the most durable and least reflecting material obtainable—dead-black velvet. A rewind device operated from the outside of the case makes it possible to lock the mechanism and allow the driving



Close-up view of the mechanism of the American Projectoscope, showing the lamp, film loop, film magazine and the fire traps of the magazine. The lens is mounted as shown while the projector is being carried.

sprockets to idle. The reel can then be rewound by hand at a high speed.

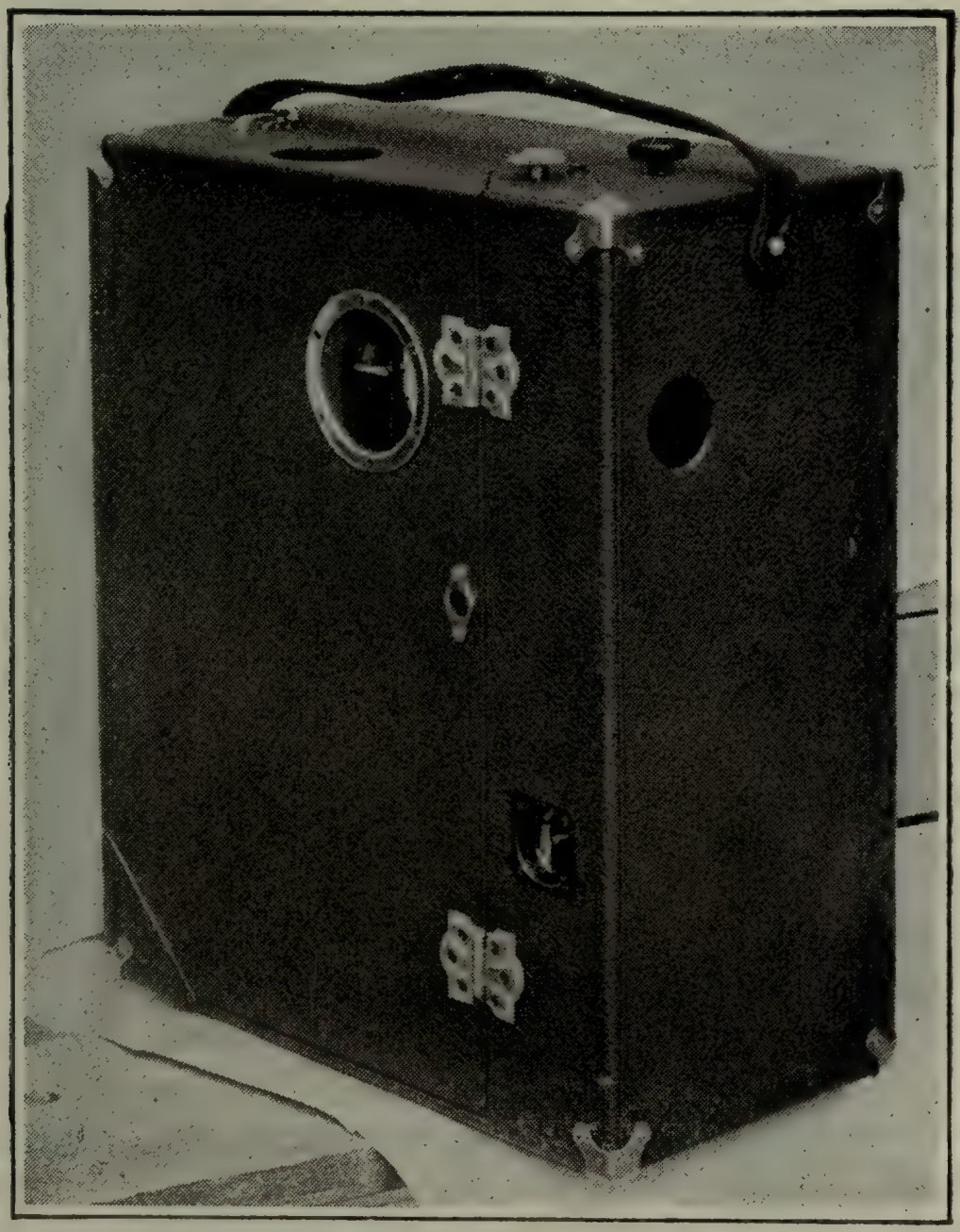
The projection lens of this projector is composed of two sets of compound lenses. These lenses can be obtained ground to different focal lengths which

vary the projecting range from one to eighty feet. The lamp is mounted nine inches from the aperture, allowing the light to be cooled before it reaches the film. A system of three condensing lenses concentrates the full value of a 200-watt nitrogen incandescent bulb, which produces an extremely brilliant and white light. The lamp housing is made of aluminum and is asbestos-lined, designed to carry most of the heat off at the side or out through the top.

There are two magzines, each having a separate door with the film entrance protected by patented roller snuffers, which are claimed to prevent any flame from reaching the interior. The reel shafts which project into the magazines are mounted on ball bearings.

Still another type of portable projector is the Universal, which is shown in the accompanying illustrations. This machine is small, compact and light, yet projects an excellent screen image. It takes standard film up to 1,000-foot lengths and operates from any lamp socket, either alternating or direct current, or from a storage battery. The lamp is only 25-volt 100-watt rating, which means a minimum of heat and a minimum of fire danger.

The accessibility of the Universal projector is quite characteristic of its construction. It is easy to thread the film in this machine, because the suitcase cabinet can be thrown open by swinging the two sides out and clear of the bottom section which holds the mechanism. Thus every part may be readily reached for threading, inspection, oiling or even repair.



The Universal projector, entirely closed and ready to be carried. This machine uses a 25-volt 100-watt gas-filled incandescent lamp and operates up to 80 feet distant from the screen.

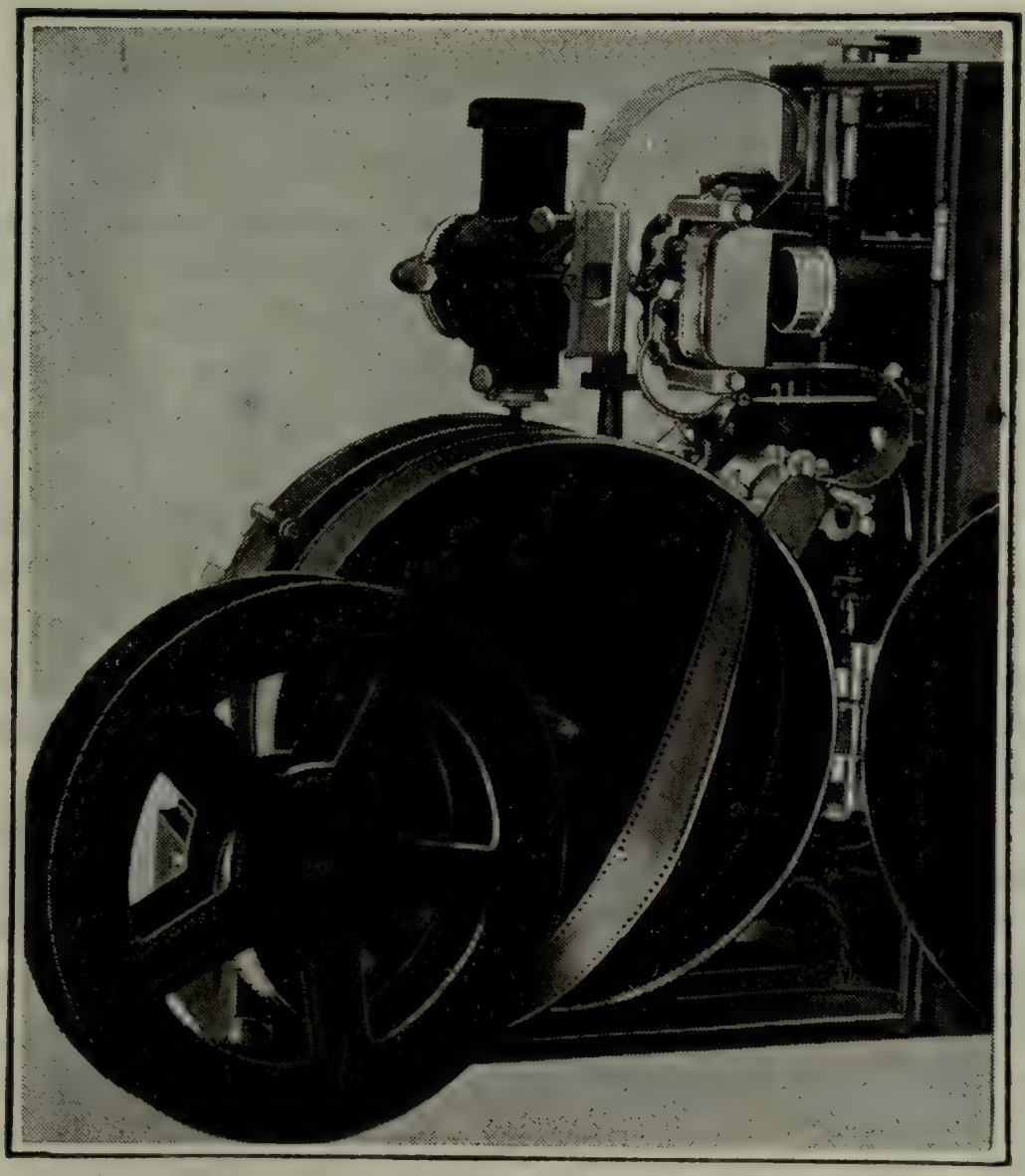
A universal motor which can be used on either alternating or direct current supplies the driving power. The motor drives through a worm gear shaft. The machine is reversible; by means of a special

switch on the outside of the case, the film may be quickly reversed for purposes of repetition without rethreading.

The intermittent movement of the Universal projector deserves special mention. By means of an exclusively designed and patented twin star and cam intermittent movement, a brighter, clearer and steadier picture is obtained than is the case with many other projectors of the portable variety. In fact, the flicker is reduced to a minimum. This is accomplished by a speed ratio of 6 to 1. By this speed ratio the film moves in one-seventh of the time and remains stationary six-sevenths of the time, making the travel time of film 1/114 part of a second, and insuring better definition of picture on the screen. The twin intermittent movement is said to eliminate the old style tension shoes and therefore reduces the strain on the sprockets and lessens the wear and tear on the film.

An illuminating system that throws an intense light, using a standard 25-volt 100-watt tubular gas-filled incandescent lamp having a concentrated filament, is incorporated in the construction. The lamp is backed up with a highly polished mirror reflector and, in connection with the specially designed condenser, will throw a brilliant and distinct picture any distance up to 80 feet and from a small screen image to one 8 feet in width.

Both reels are enclosed in separate metal containers. An automatic fire shutter is provided which comes down over the aperture opening the instant the film stops. The film may be rewound by hand



Mechanism of the Universal projector. The doors of the case swing back so as to make every part of the mechanism readily accessible.

or power into one of the containers without operating or going through the mechanism. The framing may be done while the machine is in operation.

Reproducing the Theatrical Projector in Miniature

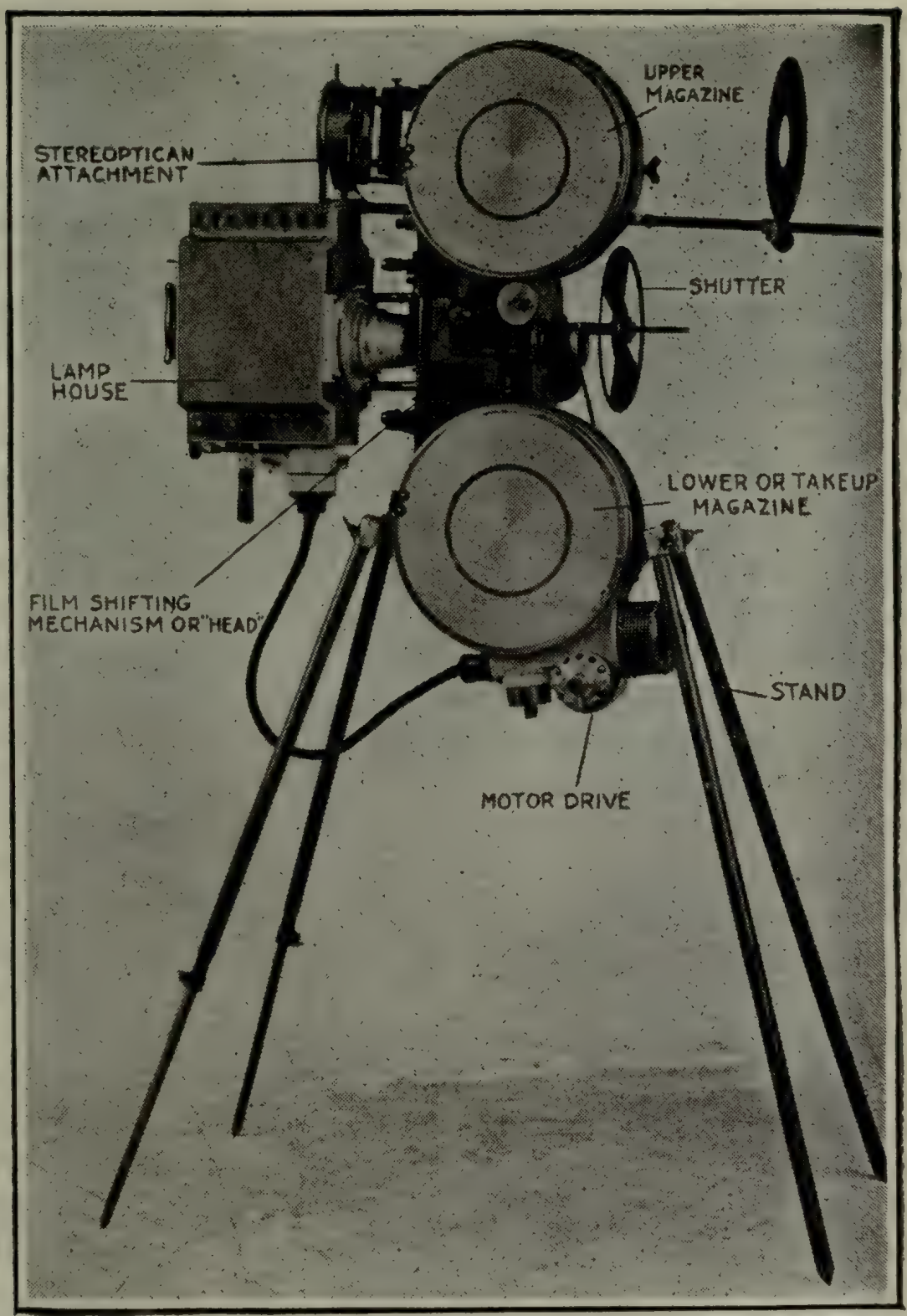
So much for the suit-case type of portable projectors. Among the several offerings of semi-profes-

sional projectors is the Zenith projector, which is in every way capable of projecting pictures comparable with those in the regular run of motion picture theatres. In fact, it may be considered side by side with the standard projector, except where extremely long throws and large screen sizes are required, such as in our largest picture theatres.

The Zenith projector looks very much like the standard theatrical projectors, to be sure; and the author was very much impressed with the demonstrations of its work. It has a capacity of 1,000 feet of standard film, while the stereopticon arrangement takes the usual 3¼ by 4¼ inch lantern slides.

First of all, the Zenith has magazines of thick aluminum construction, with latches and felt safety fire valves. The lamp used is a 1000-watt, 110-volt incandescent lamp. The lamp house is large and well ventilated, keeping the lenses cool. Adjustments of light reflector are possible in all directions and are easily and quickly made by large hand-screws. The light can be shifted from the motion picture mechanism to the stereopticon without adjustment.

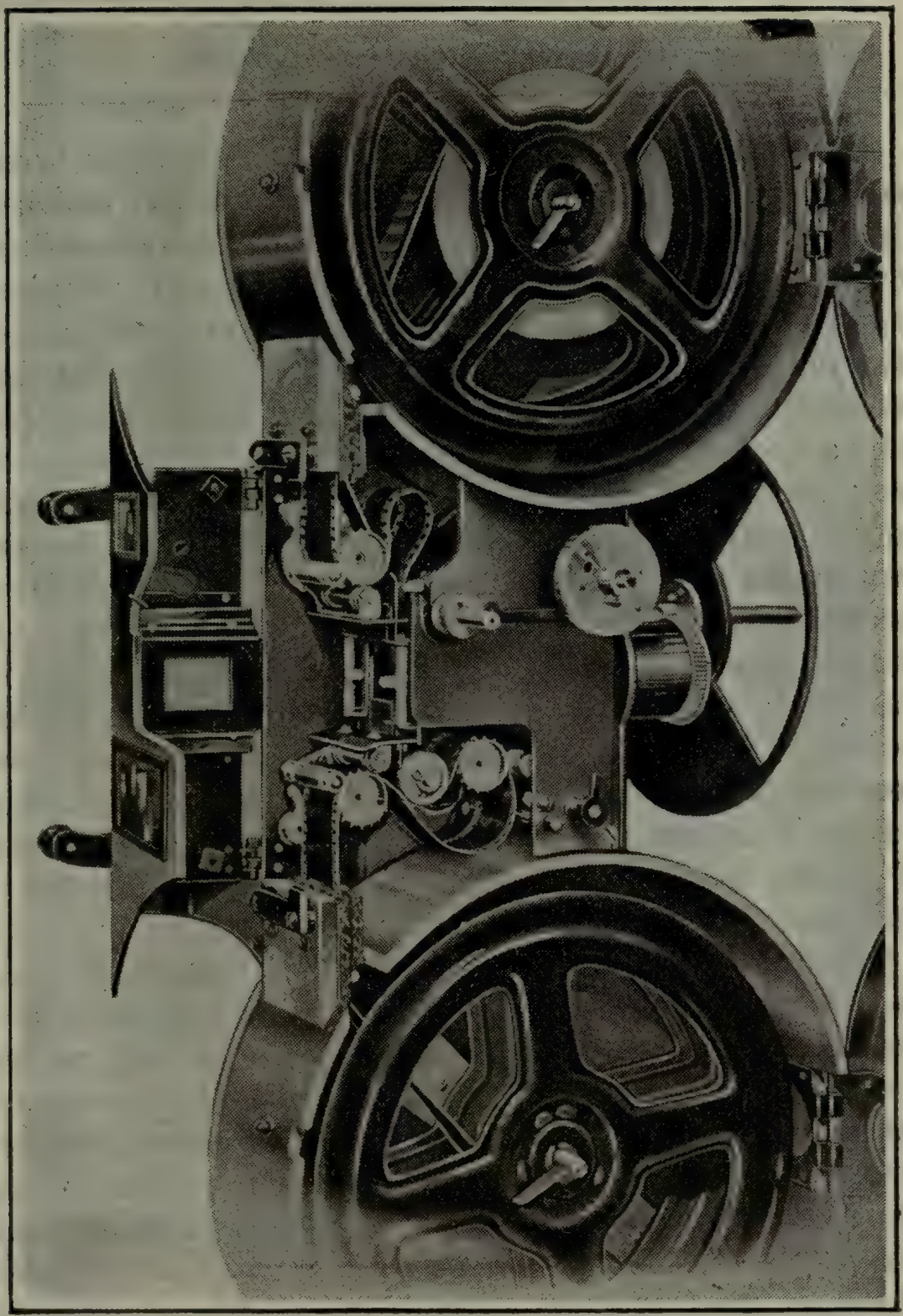
Following the modern practice, the motor drive is employed. A universal motor for 110-volt direct or alternating current, with speed controller adjustable at the turn of a lever, furnishes the driving power. Hand power can be used if desired. Rewinding is accomplished by means of a hand crank that is placed on the upper reel and serves quickly to rewind film from the lower to the upper reel, when operating in the field.



The Zenith semi-professional projector, which contains practically all the elements of the large theatrical projectors, The machine will project pictures of the same quality as the theatrical pictures for the largest schoolrooms, churches, clubrooms, and other non-theatrical gatherings.

The intermittent movement makes use of the usual Geneva star and cam. It is easily adjusted to take up wear, merely by loosening one screw and moving a small lever. The framing is extremely simple, being accomplished by a convenient handle while the machine is running. A safety shutter, which is entirely automatic in its operation, opens as the machine starts up and closes when the speed drops below normal, shutting light off at once from the film. The film is entirely enclosed in a fire-proof case at all times, only the center of one picture being exposed to light when running, even the edges being covered. Safety chambers block the film and stop the machine at once in case of broken film. In fact, one of the convincing tests made with the Zenith projector in order to show its fire-proof features, is to open the safety shutter and, while the machine is stopped, allow the film to catch fire from the light. This it does, but only the space of a single frame is destroyed, the rest of the film being undamaged.

The film take-up is automatic and winds the film snugly on the lower reel. Legs are quickly detachable from the machine, yet when in place are strong and rigid. The front legs are adjustable for height. The material consists of cast aluminum with glass windows for the frame and body. The gears are of phosphor bronze and steel, bronze bushed. The bearings are of phosphor bronze. The weight of the Zenith projector, complete, is 65 pounds, so that despite its rugged construction and professional appearance it is still quite portable.



Close-up view of the mechanism of the Zenith projector. Only one frame of the film is exposed to the powerful beam of light at one time, and at most only one frame of the film can possibly burn if the film should become ignited.

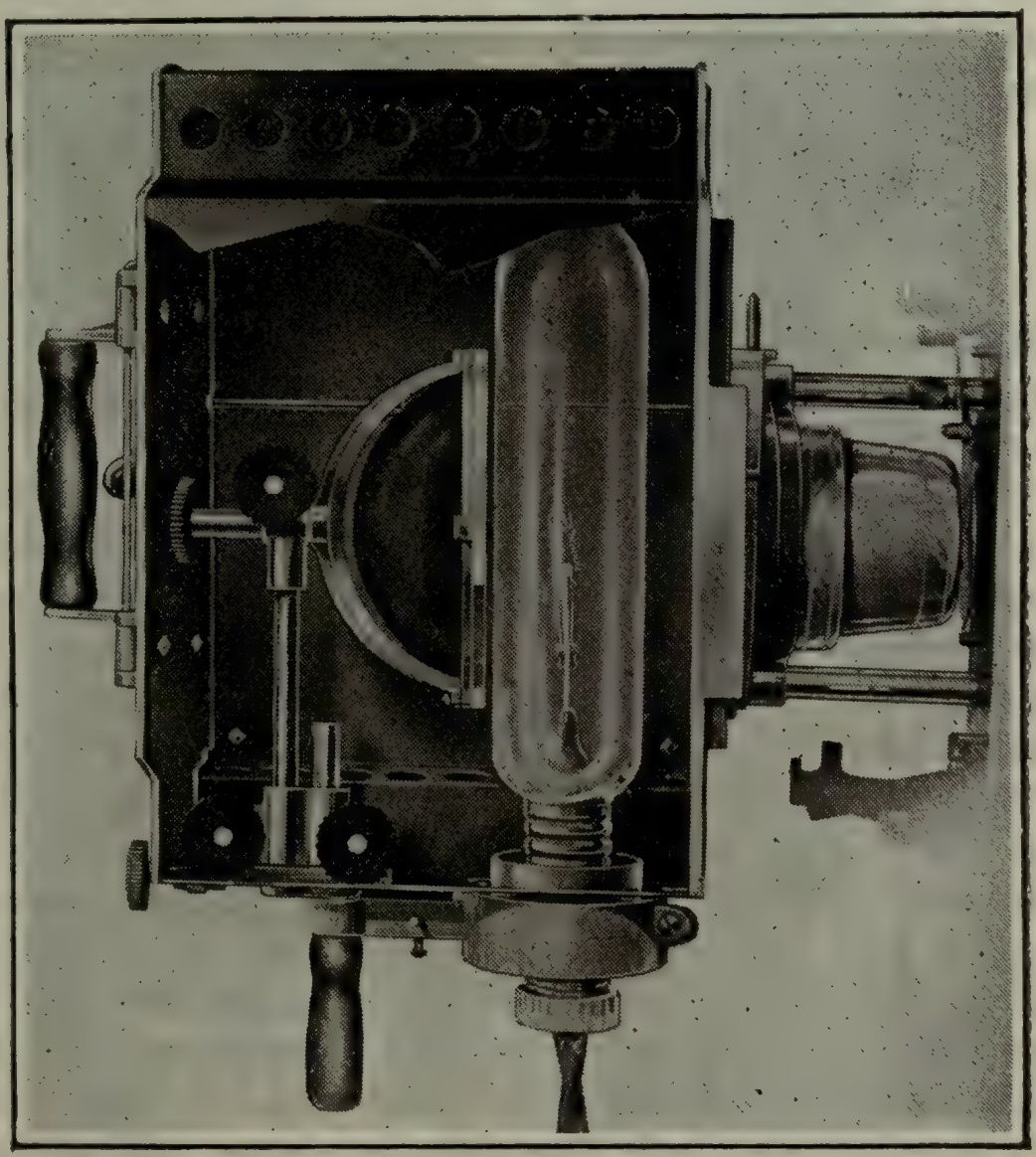
Somewhat similar to the Zenith projector, in broad outlines, at least, is the Burwood projector, which is also designed to meet the particular requirements of educational, social, civic, industrial and religious organizations which use the screen for purposes of instruction and entertainment. The Burwood has enclosed film magaiznes, incandescent lamp, stereopticon attachment, entirely enclosed mechanism, and four legs that can be adjusted to any height and angle desired. The machine can be driven by its own motor or by hand. The design of the worm drive mechanism, an exclusive feature of the Burwood, is simple and efficient. It operates on the principle of the single shaft drive, which gives a constant sliding motion, thus reducing vibration to a minimum and producing pictures of greatest distinctness. The Burwood design seems to be composed of a minimum of parts, and therefore should cost very little to maintain in order.

Other projectors, such as the Cosmograph, in this same general division have very much the same features. There are several European offerings which are somewhat less costly than their American counterparts, yet with all fairness to them it seems that their construction is inferior to our domestic makes. Then again, some of the European machines have exposed film reels—no fire-proof magazines are employed—which, it goes without saying, is dangerous practice.

A Different Machine Designed by a Pioneer

The Graphoscope is a new motion picture projecting machine, unique in many features, and abso-

lutely distinctive. It has been designed by C. Francis Jenkins, of Washington, D. C., who is a pioneer and an authority in motion pictures.



The lamp house of the Zenith projector, showing the tubular gas-filled incandescent lamp and the reflector. The condenser is located in the cone-shaped member at the right.

First of all, the film-handling mechanism of the Graphoscope is inclosed in a box, with a glazed door.

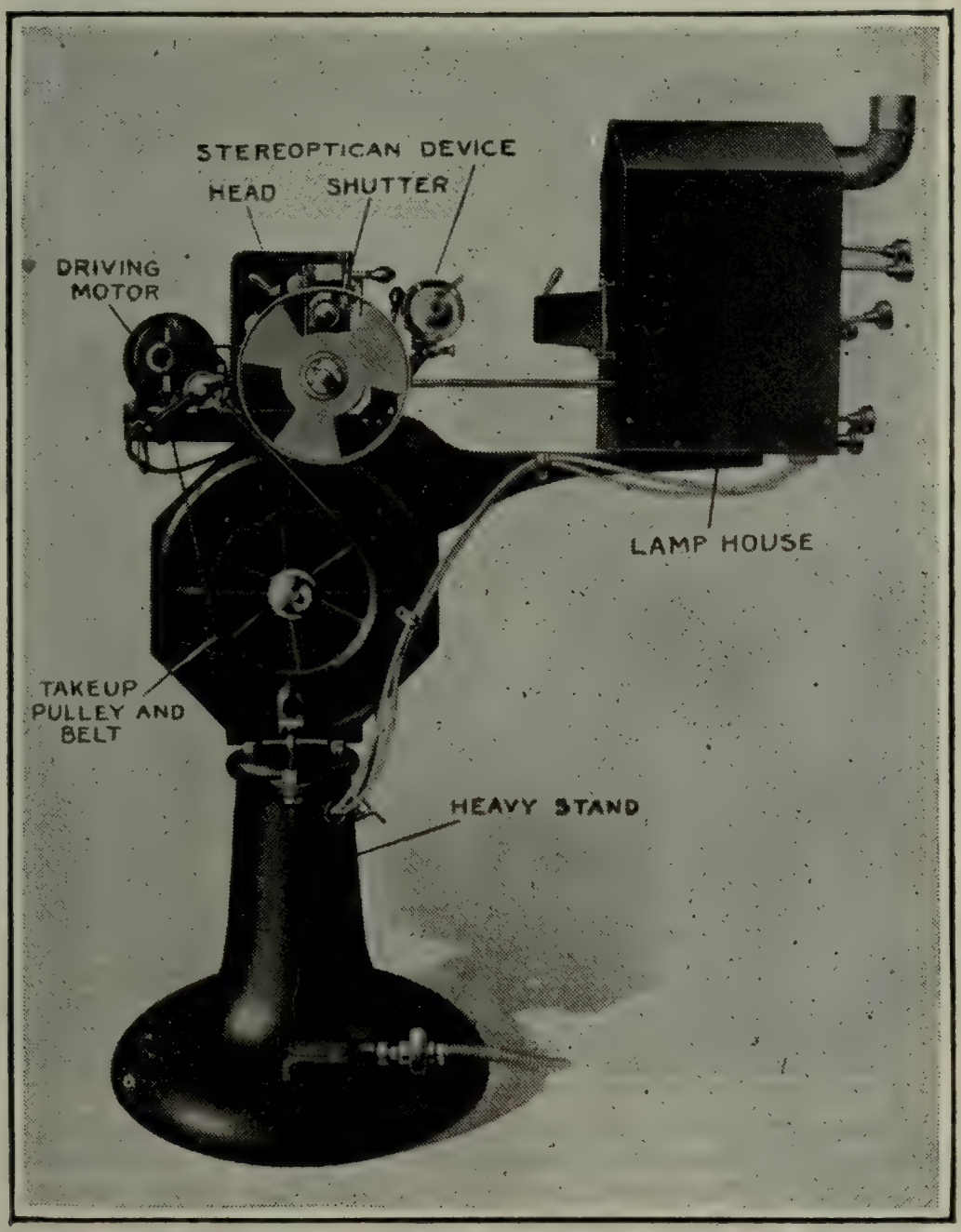
The Geneva gears are in a box of oil, and silent connecting rods are used in place of the usual gear train. Ball bearings are used on the heavier shafts, and the sprocket teeth are of tool steel. All handles are within easy and comfortable reach of the operator.

The film tension members are long, hardened steel strips which bear lightly against the film. For this reason, and because the film comes in contact with few sprockets, rollers and similar devices, it is claimed that the strain on the film is reduced to the smallest possible amount and the life of the film is correspondingly lengthened.

The reels are supported side by side in the base of the machine below the probable source of ignition, and sealed with fire-quenching rollers. In the same metal box the films can be rewound after the show is over, for the rewind is direct-belted to the motor, relieving the mechanism of this source of wear.

The Graphoscope Junior, which is the smaller machine, uses standard film and projects brilliant pictures up to 12 feet wide, with projection distances up to 100 feet. For larger pictures or a greater throw the Graphoscope professional model with its arc lamp alone is suitable. The magazine takes the universal 10-inch reel of 1,000 feet of film. All wiring is concealed, the switch wiring and connections being enclosed in the magazine.

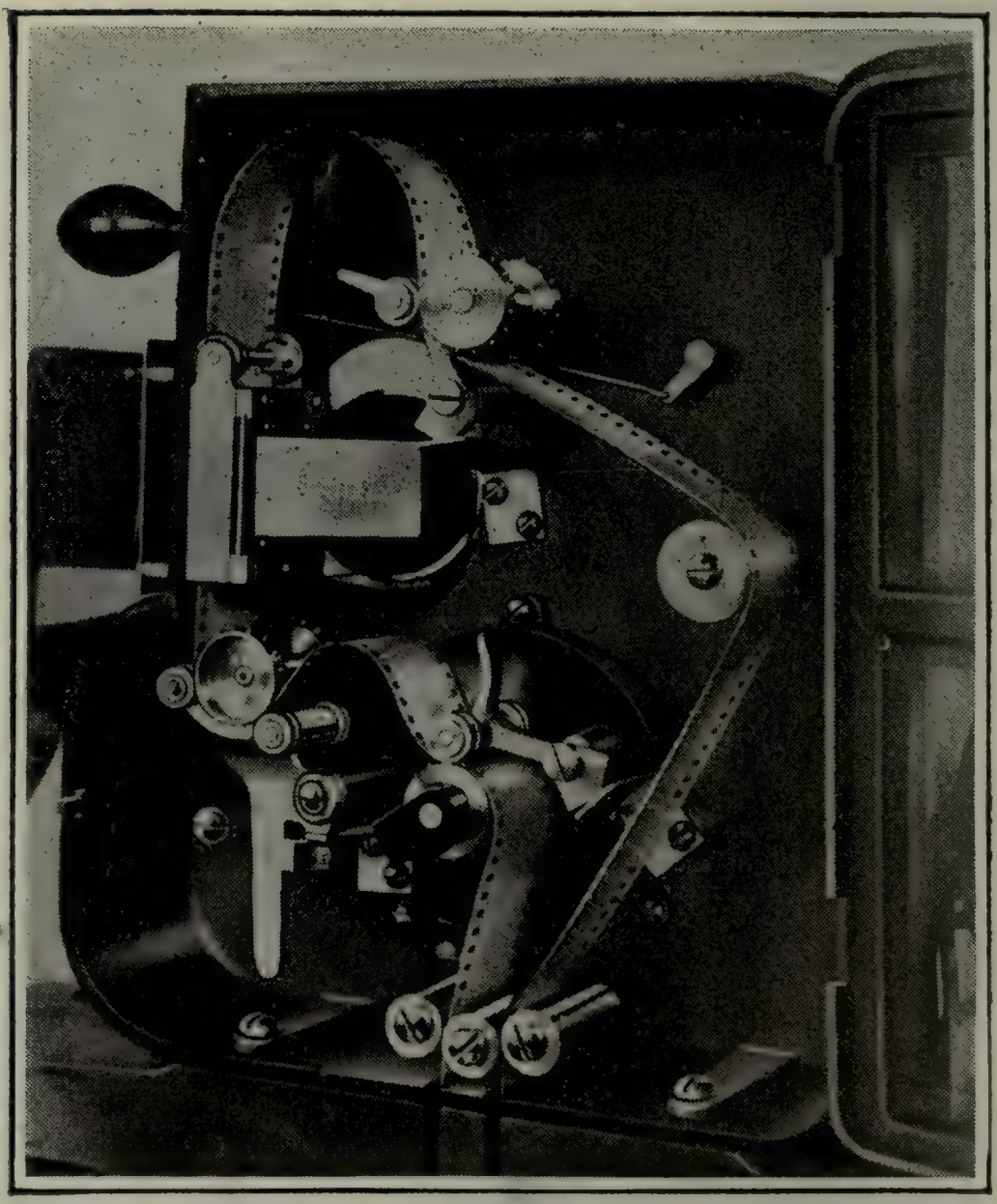
The adoption of a total refracting prism of finest lens glass gives a beauty of screen picture which is claimed to be unusual, and also enables the shutter to be mounted directly on the Geneva drive shaft,



The Graphoscope projector of medium size, suitable for use in the large auditorium or small-sized theatre. Unlike the usual projectors, this machine has the lamphouse arranged at right angles to the projected beam.

thus eliminating slack between shutter and Geneva drive.

The Graphoscope Junior is readily carried from one classroom to another, when used in schools, and



Close-up view of the mechanism of the Graphoscope. The film comes up from the magazines below. The beam of light from the lamp house comes in from the left, passes through the film, and is bent by the prism so as to pass out through the lens.

when set on a table, desk or the like, is ready for instant projection. There are no legs to fasten on or loose pieces to be accidentally left behind. The current is taken from any standard lighting socket.

The adoption of a triangular connecting rod instead of a train of gears to synchronize the upper

and lower sprocket is claimed to reduce wear, and, incidentally, makes the machine more quiet. The driving system is simple and unique in design. The power is applied through a mechanical speed adjustment to the intermittent drive shaft, where the most power is needed, and through a decreased ratio to the sprockets.

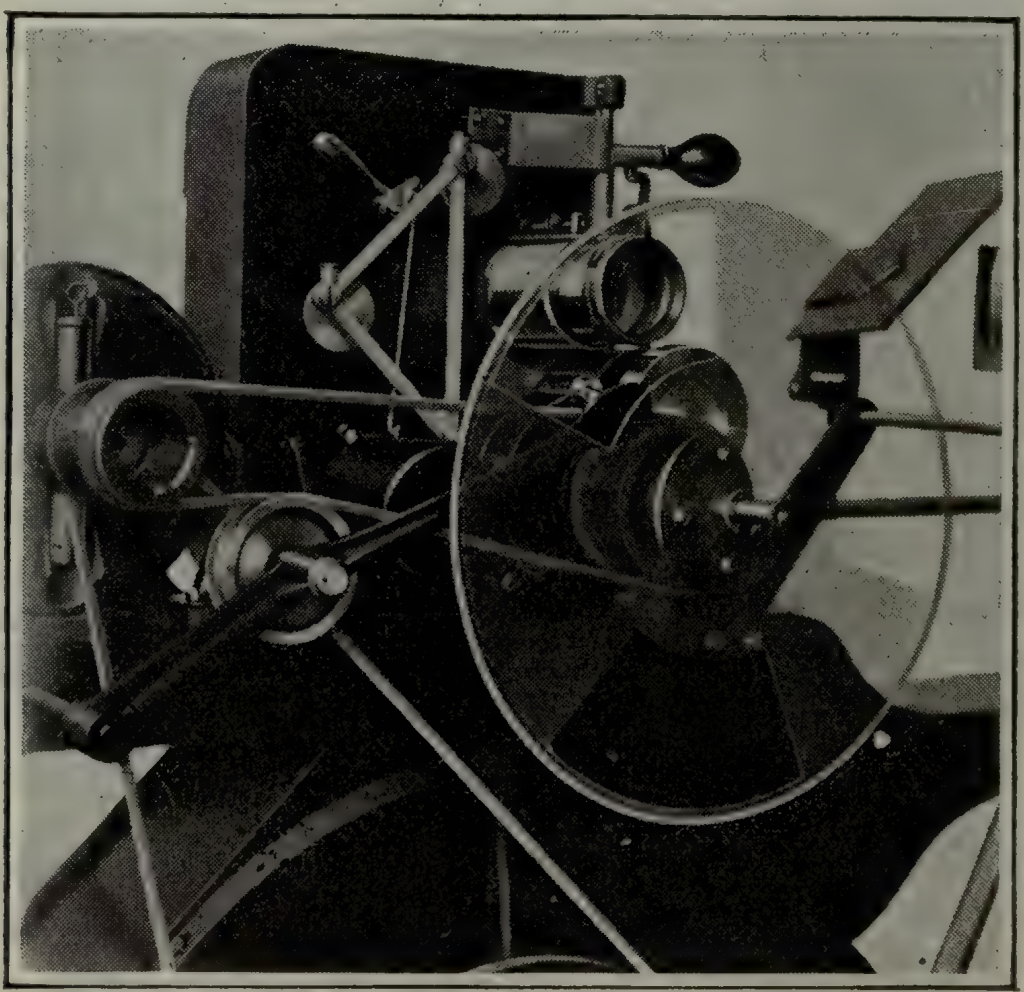
One of the new incandescent lamps is employed, and the magazine of the Graphoscope Junior forms the support for the mechanism, motor, and lamp house. The construction is claimed to be absolutely fire-proof, for the film in use is locked up in a single metal magazine below. Even the loops and length of film in the intermittent mechanism of the projector are enclosed in the glazed metal case.

There are several other projectors in the semi-professional field which space does not permit us to review. However, those already mentioned serve to represent the class.

The Big Machines of the Professionals

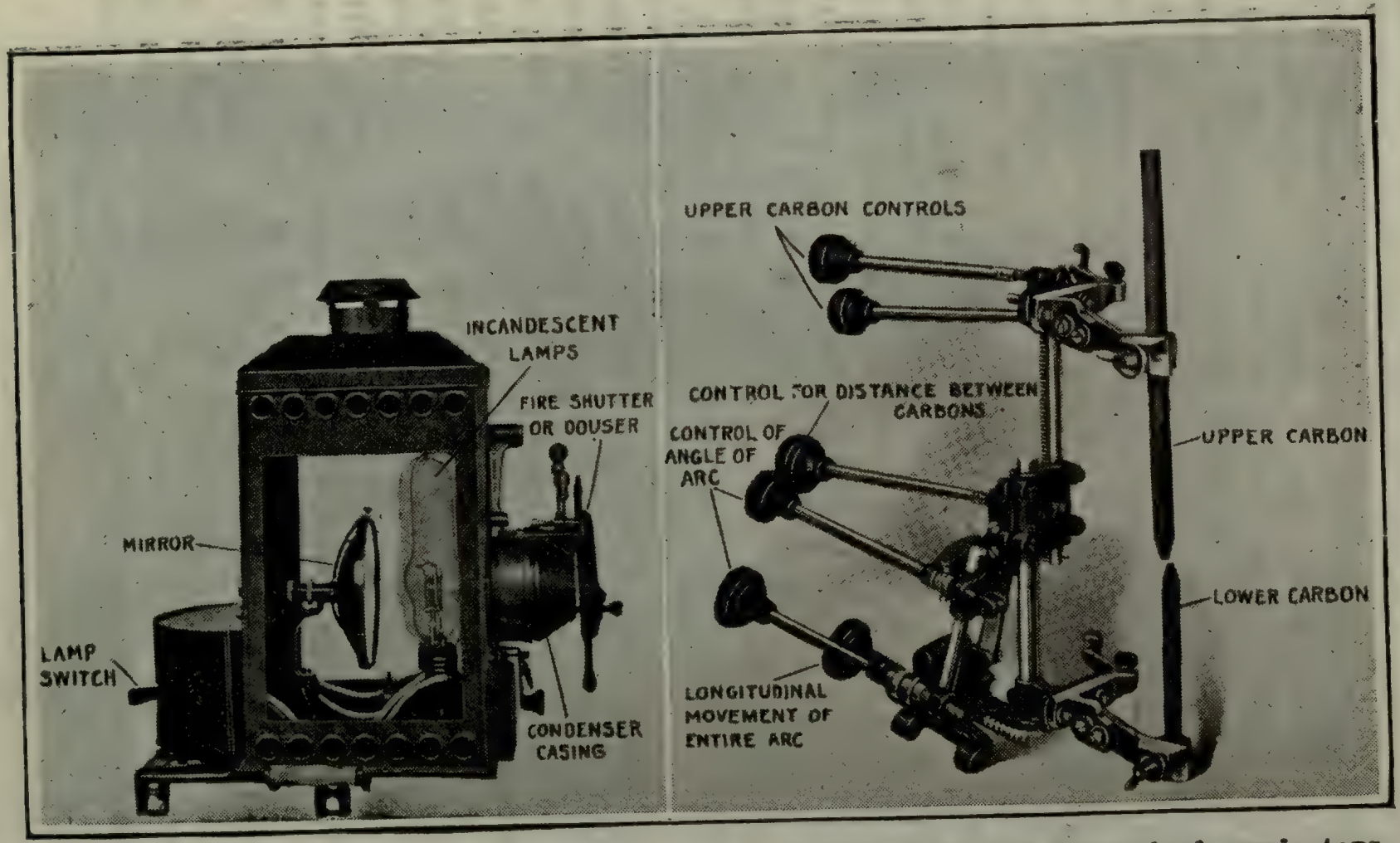
The Graphoscope, big brother to the Graphoscope Junior, is intended for theatrical or professional use. Its constructional features are practically a duplication of those of its smaller brother, except, of course, on a much larger scale. The use of the prism to project the light laterally is pointed out as increasing the space in the projection booth, for the machines stand parallel to the front wall of the booth. The arc lamp, which is now used because we are dealing with professional work, is of the universal two-carbon type, of substantial ccnstruction and

provided with all adjustments. Double walls and a ventilator flue keep the lamp house surprisingly cool. The incandescent spot of the positive carbon is maintained in the axis of the lens without shadows



Front view of the Graphoscope head, showing the shutter, lens, and the ingenious triangle member which takes the place of the usual elaborate gearing for transmitting the power to the various sprockets.

from a large negative carbon. This brings the incandescent spot of the positive carbon in the exact focus of the condensing lens, the latter being mounted in a moulded lens-holder having a plurality of lens



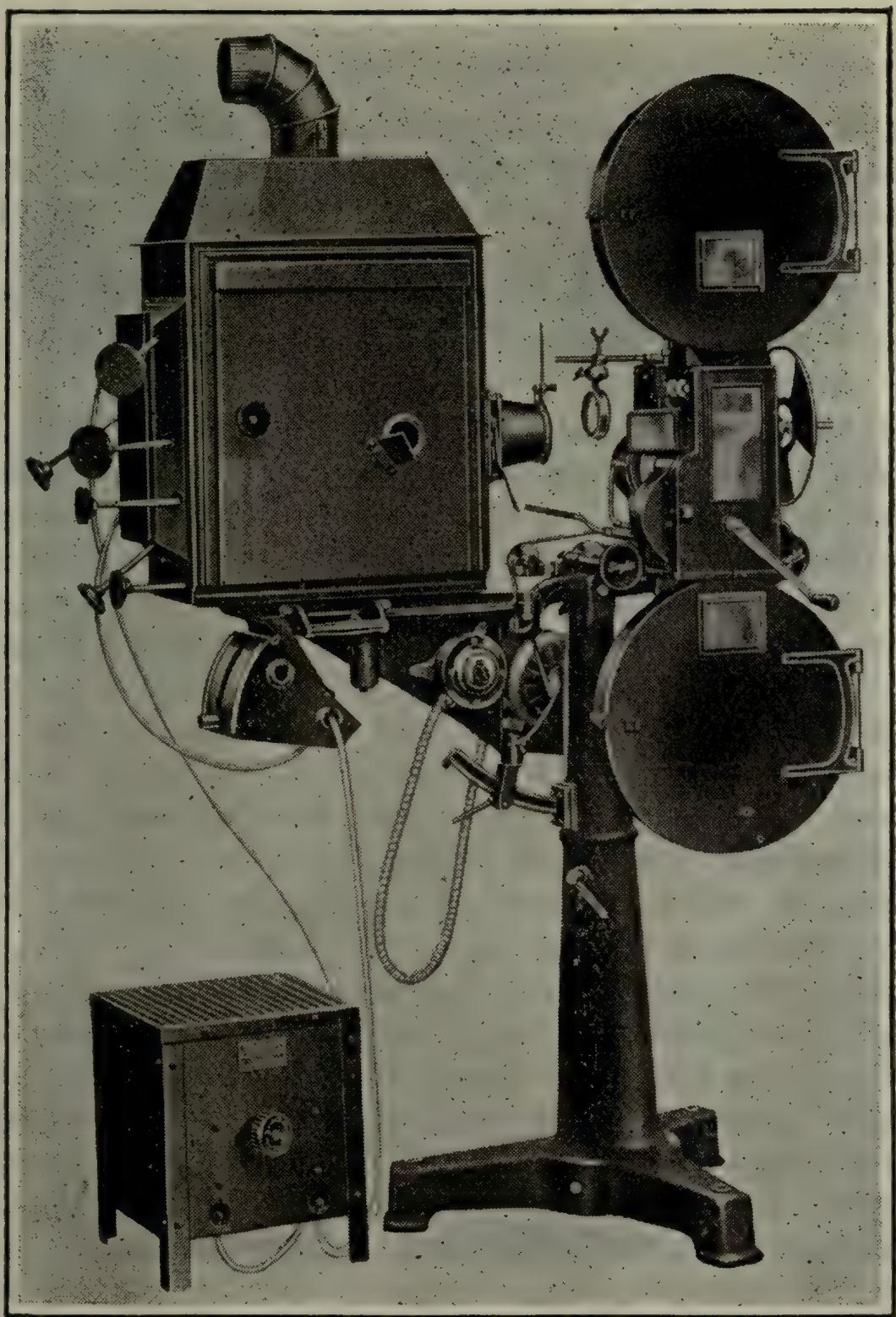
Typical lamp house with incandescent lamp employed on the theatrical projectors of limited throw, and a typical arc light employed in theatrical projectors of medium size.

grooves therein. For this reason the greatest efficiency is said to be obtained, and no condenser breakage is experienced.

We have dealt with the Graphoscope only because in this case it is considerably out of the ordinary among professional type machines. When it comes to other professional projectors now in general use, the author has not picked out any one make for the reason that this would not be fair to others. At any rate, the professional projector today is more or less of standardized design an construction, like most of the other machinery in the motion picture industry. There are the Powers' Cameragraph, Simplex, Motiograph, Baird, and others.

The main point of variance between professional and non-professional projectors is in the matter of size and projecting capacity. The professional machines are more heavily built in order to meet the gruelling service of the theatre, and in order to project pictures a great distance and to fill a larger screen. These requirements naturally call for more powerful light than is ever required in amateur work, and for that reason the arc lamp is employed. In fact, the main point of variance, after all, between the professional and non-professional projectors is that the latter do not use arc lamps today, making use of the incandescent type exclusively, while the former use arc lamps in almost all instances. There is a tendency, however, to use incandescent lamps today in the professional projectors of medium throw.

The advantages of the incandescent lamp are mani-



One of the several leading types of professional projectors employed in theatres. An electric motor drives the machine so that the operator can devote his time to other duties.

fold. Better projection results, as well as greater convenience. When once adjusted, the incandescent lamp requires no further attention, and so permits the operator to devote his entire time and thought to the actual projection of the picture. Carbon adjustment is eliminated and a steadier illumination is assured.

The best results are obtained when the incandescent lamp is used in its proper sphere of duty. To expect it to project a 16 by 20 foot picture will only result in disappointment, for that is strictly in the province of the powerful arc light. This simple statement of fact must not be misconstrued. Where the length of throw and size of picture permit its use, it will produce results in every way the equal of, and in some cases superior to, those of the arc lamp equipment. The incandescent lamp can be used for all professional projection where the size of picture desired is 10 by 13 feet or less, and the throw not over 90 feet.

But the professional machine is the professional man's machine, and the amateur is little concerned with it outside of knowing what a professional projector looks like and how it differs from the non-professional types. Suffice it to say that there are several excellent works on the subject of professional projection, so that little could be done here in the way of contributing to this branch of the motion picture art in the limited space at our disposal.

Chapter VII.

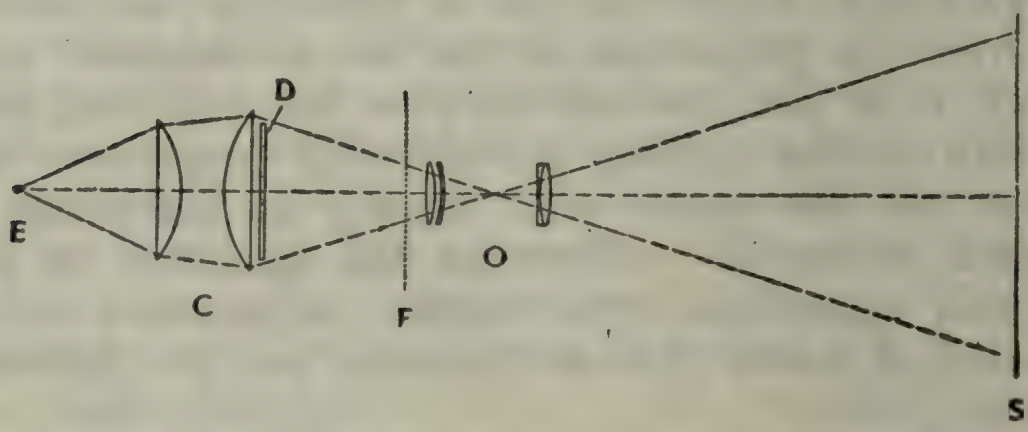
PROJECTING AND CARING FOR THE POSITIVE FILM

BEFORE launching on a discourse on motion picture projection of the non-professional category, it is perhaps well to give the following brief review of the leading principles of projection compiled for the reader who, having no knowledge of optics, wishes to understand the operation of projection apparatus. The author is indebted to the Bausch & Lomb Optical Company for this information.

With the aid of the apparatus we throw or project upon a screen an enlarged image of a transparent object, either in the form of a glass slide or film. The process is almost the reverse of ordinary photography. For example, in photographing a scene by means of the photographic objective or lens, we obtain a reduced image of that scene on the ground glass. This glass is replaced by the sensitized plate and by the use of chemicals is fixed thereon. Now in projection we reverse this process. From the picture made with the lens we make a transparent slide, or we use a positive film, and by means of a condensed light we strongly illuminate these, while with an objective lens an enlarged image is projected upon the screen, this screen image corresponding with the real objects first photographed.

Again a Matter of Optics

From this illustration it will be seen that the first essential in projection work is the lens or objective. Just as in photography the quality and tone of the picture depend to a very great extent upon the quality and character of the lens, so in projection



General scheme of projection, showing the passage of the beam of light from the illuminant to the screen.

the objective is the factor which determines the excellence of the screen image.

The condensing lenses must be of a diameter slightly larger than the diagonal of the slide or film in use.

As the condensing lenses are in close proximity to the arc or other source of light, they are, of course, subjected to considerable heat and will expand and contract accordingly as they are heated or cooled. Some arrangement should, therefore, be made for this expansion and contraction so that it will be as even as possible.

The optical principle of projection for both lantern

slide and moving picture apparatus will be more readily understood from the accompanying diagram.

At *E* is an electric light or other suitable illuminant the light from which is caught up by the condensing lenses or condenser *C;* this condenser is an arrangement of lenses so constructed as firstly to gather up as great a volume of light as possible, and secondly, to concentrate the light which it gathers at the center or diaphragm plane of the objective when the objective is located at the proper distance from the slide or film, which distance is determined by the focal length of the objective.

The slide or film should be placed at such a point that the entire area of the opening is fully illuminated, and it should also be placed so that the greatest number of light rays possible should pass through it. Taking into consideration the fact that the opening in the mat in the lantern slide is 2¾ by 3 inches, and in the moving picture film is 11/16 by 15/16, it will at once be evident that the slide must be placed at the point *D* in the diagram in order that its entire area be covered, and the moving picture film must be located at the point *F* in order that it may take in the greatest number of light rays.

Proceeding from the slide the light passes through the objective *O*, where the rays cross and the object is hence reversed, and by means of the objective the object is imaged or delineated upon the screen *S*. The degree of sharpness and flatness of the image depends upon the optical correctness of the lens.

The relative positions of the arc or incandescent

lamp used as the illuminant, condenser, and objective must be such that an image of the light source will be formed at the diaphragm of the objective. All the light coming from the condenser is then utilized and the image on the screen is at its brightest.

Oftentimes lantern slides and films are used interchangeably, and approximately the same sized image is desired with both. As the opening in the slide mat is approximately three times that of the moving picture film, it is, therefore, necessary to have a lens for lantern slides approximately three times the focal length of that of the lens used for films. It is possible to match the size of the images in one dimension only (either width or height) as the two openings are not proportionate in size.

It is necessary, therefore, in ordering lenses for such purpose, to specify whether the images are to be the same height or width.

Selecting a Lens for Projection

The most important consideration in projection work is the lens, for on its selection depend the quality and size of the image on the screen. Not the lens mounting, nor even the diameter of the lens itself, but its equivalent focus and distance from the screen, determine the size of the image.

At a given distance the greater the focal length the smaller will be the image. Shorter focus lenses, therefore, will give large images. Do not make the mistake of selecting lenses of such short focus that the magnification will be so great that when the observer is near the screen much of the definition

and perspective will be sacrificed. Brilliant pictures of medium size are far more satisfactory. However,

Equiv. focus Inches	15 ft.	20 ft.	25 ft.	30 ft.	35 ft.	40 ft.	45 ft.	50 ft.	60 ft.	70 ft.	80 ft.	90 ft.	100 ft.
2⅛	4.3	6.4	8.0	9.6	11.3	12.9	14.5	16.1					
	6.5	8.7	11.0	13.2	15.4	17.6	19.8	22.0					
2½		5.4	6.8	8.2	9.6	10.9	12.3	13.7	16.4				
		7.4	9.3	11.2	13.1	14.9	16.8	18.7	22.4				
3		4.5	5.7	6.8	8.0	9.1	10.3	11.4	13.7	16.0			
		6.2	7.7	9.3	10.9	12.4	14.0	15.6	18.7	21.8			
3½			4.9	5.8	6.8	7.8	8.8	9.8	11.7	13.7	15.7		
			6.6	8.0	9.3	10.6	12.0	13.3	16.0	18.7	21.4		
4			4.2	5.1	6.0	6.8	7.7	8.5	10.3	12.0	13.7	15.4	
			5.8	7.0	8.1	9.3	10.5	11.6	14.0	16.3	18.7	21.0	
4½				4.5	5.3	6.2	6.8	7.7	9.1	10.6	12.2	13.7	15.4
				6.2	7.2	8.4	9.3	10.5	12.4	14.5	16.6	18.7	21.0
5					4.8	5.4	6.1	6.8	8.2	9.6	10.9	12.3	13.7
					6.5	7.4	8.4	9.3	11.2	13.0	14.9	16.8	18.7
5½					4.3	4.9	5.6	6.2	7.4	8.7	9.9	11.2	12.4
					5.9	6.7	7.6	8.4	10.2	11.9	13.6	15.3	17.0
6						4.5	5.1	5.7	6.8	8.0	9.1	10.3	11.4
						6.2	7.0	7.7	9.3	10.9	12.4	14.0	15.6
6½							4.7	5.2	6.3	7.3	8.4	9.6	10.6
							6.4	7.1	8.6	10.0	11.4	13.0	14.5
7							4.4	4.9	5.8	6.8	7.8	8.8	9.8
							6.0	6.6	8.0	9.3	10.6	12.0	13.3
7½								4.5	5.4	6.4	7.3	8.2	9.1
								6.2	7.4	8.7	10.0	11.2	12.3
8									5.1	6.0	6.8	7.7	8.5
									7.0	8.1	9.3	10.5	11.6

Projection table for motion pictures. By glancing across from the focus figure to the column indicating the distance of throw, the screen height and width of image may be obtained.

a specially corrected series of projection lenses, recently introduced by M. H. Schoenbaum of New

York, are said to give a perfectly flat field at any distance with objectives of very short focal lengths, such, for instance, as 1½-inch equivalent focus.

The projection distance must be measured from the film or slide to the screen. The accompanying tables show the size of image obtained with lenses of different focal lengths at varying distances. Other sizes, focal lengths and distances can be computed as follows:

The size of the image can be determined by multiplying the difference between the distance from lens to screen and the focal length of the objective, by the size of the slide or film, and dividing the product by the focal length.

For example:

Let L be the projection distance, 40 feet (480 inches); S, the slide mat, 3 inches; F, the focus of the lens, 12 inches; then we have the formula (in which d is the size of the image)

$$d = \frac{S\ (L—F)}{F}$$

Substituting for the letters their known values we have

$$d = \frac{3\ (480 — 12)}{12} = 117 \text{ inches or } 9\tfrac{3}{4} \text{ feet.}$$

To determine the focal length, it is necessary to multiply the size of the slide or film opening by the distance from lens to screen, and divide the product by the sum of the size of the image and the size of the slide.

Thus we have the formula

$$F = \frac{S \times L}{d + S} \text{ and}$$

substituting their values as before

$$F = \frac{3 \times 480}{117 + 3} = \frac{1440}{120} = 12 \text{ inches.}$$

With the other factors given, we can determine the distance from slide to screen by multiplying the sum of the image and the size of the slide mat, by the focal length, and divide this product by the size of slide mat, thus:

$$L = \frac{F\,(d + S)}{S} \text{ substituting values}$$

$$L = \frac{12\,(117 + 3)}{3} = 480 \text{ inches} = 40 \text{ feet.}$$

So much for the matter of lenses and the mathematics thereof. Now we are ready to go ahead with the actual work of projecting, first considering the film and its inspection, which is a very necessary procedure if good projection is to result.

The Care, Use, and Abuse of Film

If all the film you employed were your own personal property and always under your personal care, there would be little need for inspecting the film prior to projection. But film is expensive, and new film is constantly required in order to vary one's motion picture shows. Hence it is quite obvious that one

Equiv. focus Inches	15 ft.	20 ft.	25 ft.	30 ft.	35 ft.	40 ft.	45 ft.	50 ft.	60 ft.	70 ft.	80 ft.	90 ft.	100 ft.
5	8.0	10.8	13.5	16.3	19.0								
	8.8	11.8	14.8	17.8	20.8								
5½	7.3	9.8	12.3	14.8	17.3	19.8							
	7.9	10.7	13.4	16.1	18.8	21.6							
6	6.6	8.9	11.2	13.5	15.8	18.1	20.4						
	7.3	9.8	12.3	14.8	17.3	19.8	22.3						
6½	6.1	8.2	10.4	12.5	14.6	16.7	18.8						
	6.7	9.0	11.3	13.6	15.9	18.2	20.5						
7	5.7	7.6	9.6	11.6	13.5	15.5	17.5	19.4					
	6.2	8.3	10.5	12.6	14.8	16.9	19.0	21.2					
7½	5.3	7.1	8.9	10.8	12.6	14.4	16.3	18.1					
	5.8	7.8	9.8	11.8	13.8	15.8	17.8	19.8					
8		6.6	8.4	10.1	11.8	13.5	15.2	17.0	20.4				
		7.3	9.1	11.0	12.9	14.8	16.6	18.5	22.3				
8½		6.2	7.9	9.5	11.1	12.7	14.3	16.0	19.2				
		6.8	8.6	10.3	12.1	13.9	15.6	17.4	20.9				
9		5.9	7.4	8.9	10.5	12.0	13.5	15.1	18.1	21.1			
		6.4	8.1	9.8	11.4	13.1	14.8	16.4	19.8	23.1			
9½		5.6	7.0	8.5	9.9	11.4	12.8	14.2	17.1	20.0			
		6.1	7.6	9.2	10.8	12.4	14.0	15.5	18.7	21.9			
10		5.3	6.6	8.0	9.4	10.8	12.2	13.5	16.3	19.0	21.8		
		5.8	7.3	8.8	10.3	11.8	13.3	14.8	17.8	20.8	23.8		
12			5.5	6.6	7.8	8.9	10.1	11.2	13.5	15.8	18.1	20.4	
			6.0	7.3	8.5	9.8	11.0	12.3	14.8	17.3	19.8	22.3	
14				5.6	6.6	7.6	8.6	9.6	11.6	13.5	15.5	17.5	19.4
				6.2	7.3	8.3	9.4	10.5	12.6	14.8	16.9	19.0	21.2
16					5.8	6.6	7.5	8.4	10.1	11.8	13.5	15.2	17.0
					6.3	7.3	8.2	9.1	11.0	12.9	14.8	16.6	18.5
18					5.1	5.9	6.6	7.4	8.9	10.5	12.0	13.5	15.1
					5.6	6.4	7.3	8.1	9.8	11.4	13.1	14.8	16.4
20						5.3	6.0	6.6	8.0	9.4	10.8	12.2	13.5
						5.8	6.5	7.3	8.8	10.3	11.8	13.3	14.8
22							5.4	6.0	7.3	8.5	9.8	11.0	12.3
							5.9	6.6	7.9	9.3	10.7	12.0	13.4
24								5.5	6.6	7.8	8.9	10.1	11.2
								6.0	7.3	8.5	9.8	11.0	12.3

Projection table for lantern slide projection. By glancing across from the focus figure to the column indicating the distance of throw, the screen height and width of image may be obtained.

reel must serve for a large number of projectionists, and it becomes, therefore, more or less public property. Coincidently, it is only human nature that some projectionists should not be as careful with said film as they might be, and as a result the film is often damaged in the course of its usage and travels from one place to another.

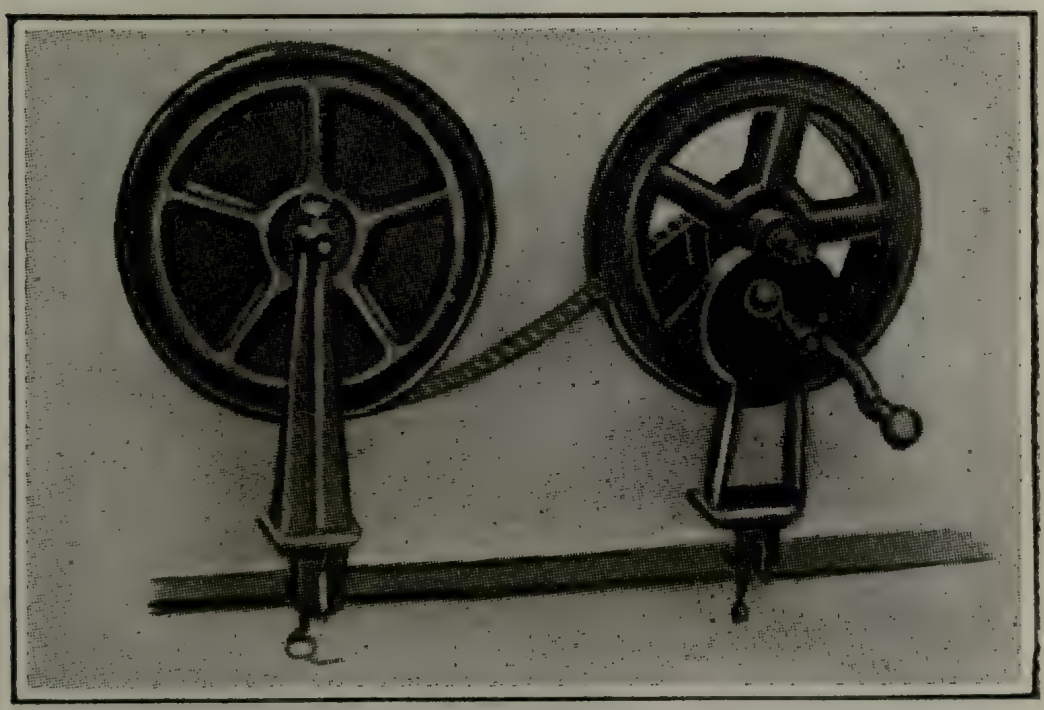
So the first step is to examine the film before projection, so that any flaws or damage may be detected and mended before the film is run through the projector, not only in order to preclude the annoying delay occasioned by the breakdown of the film, but also because damaged film is apt to cause certain complications in the projection.

Film, when received from the exchanges, generally comes rewound and ready for the projector. The reliable exchange always sees to it that the film has been inspected and repaired, and when the projectionist is dealing with a reliable exchange he need not necessarily inspect the film, especially if the time and effort can ill be spared. However, inspection is a simple procedure. Either a regular rewinder set can be used, or the film can be run through the rewinder arrangement on the projector actually employed. The reels are placed so that the film being rewound travels from left to right, with the emulsion side up. The film is grasped between the left forefinger and left thumb, with just enough pressure slightly to cup the film. In this manner it becomes possible to detect every damaged sprocket hole, tear and patch, if the rewinding is carried out at a reasonable rate of speed. Rushing the film through is apt

How film is mended. The first strip shows a damaged film with torn edges, while the second strip shows how such a film is trimmed with a pair of scissors. Rough edges are apt to catch in sprocket teeth, hence must be trimmed. Third strip indicates how a film is cut and a narrow bit cleaned for cementing, while fourth strip shows the finished splice.

to accomplish nothing, hence is only a waste of time and effort.

The damaged or torn sprocket hole should be cut as indicated in the accompanying illustration. While it is true that the defect may pass through a projector without hitch of any kind in its damaged state, the probabilities are that one part or the

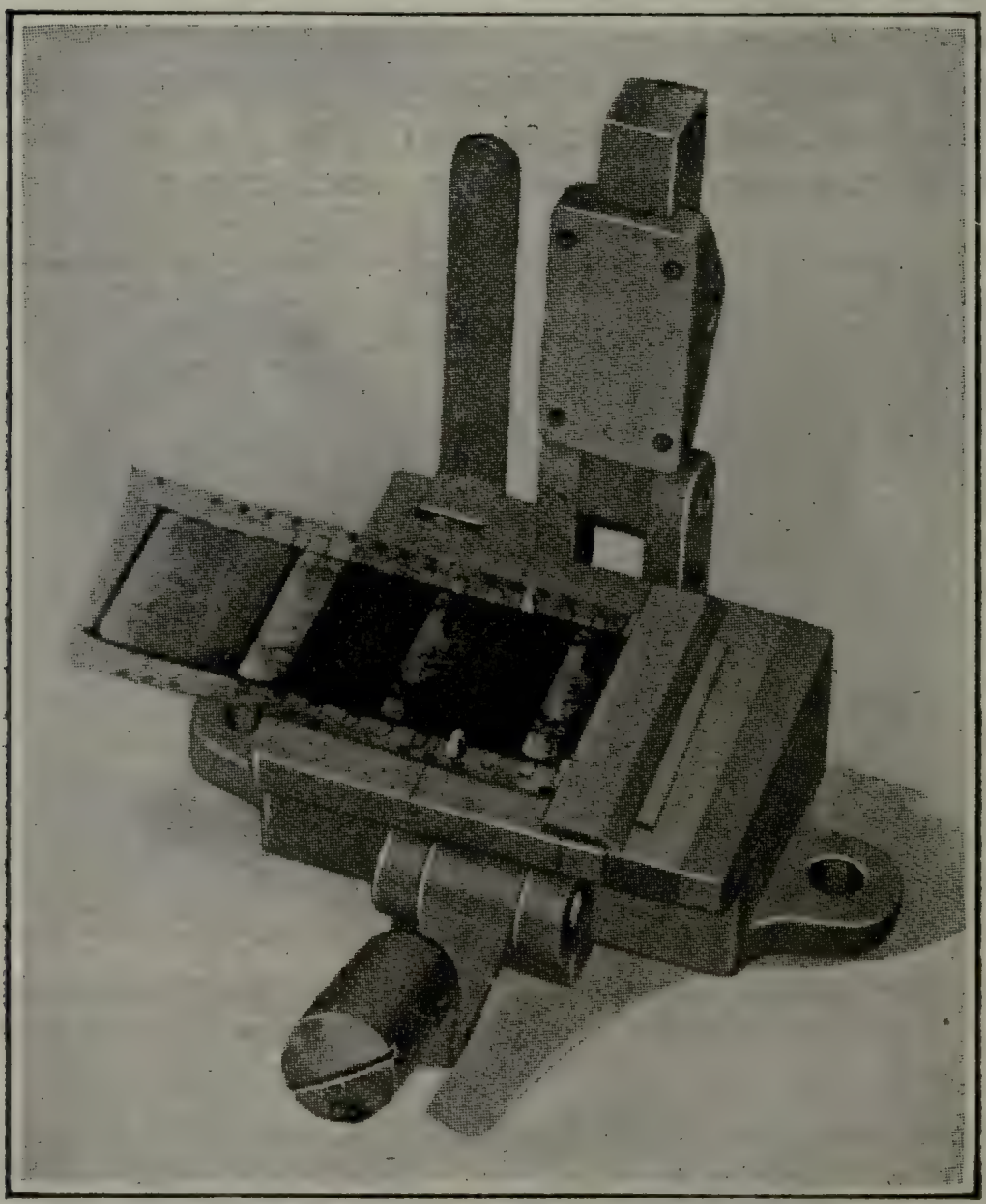


Rewinding outfit of the simplest kind employed for rewinding after projection and also for examination.

other may catch on the idler, thus tearing the film and causing the loss of the loop, and otherwise damaging the film so that the machine has to be stopped anyway. It is better to take the time required to make the repair before starting the projection.

Film is delicate, it goes without saying. A certain

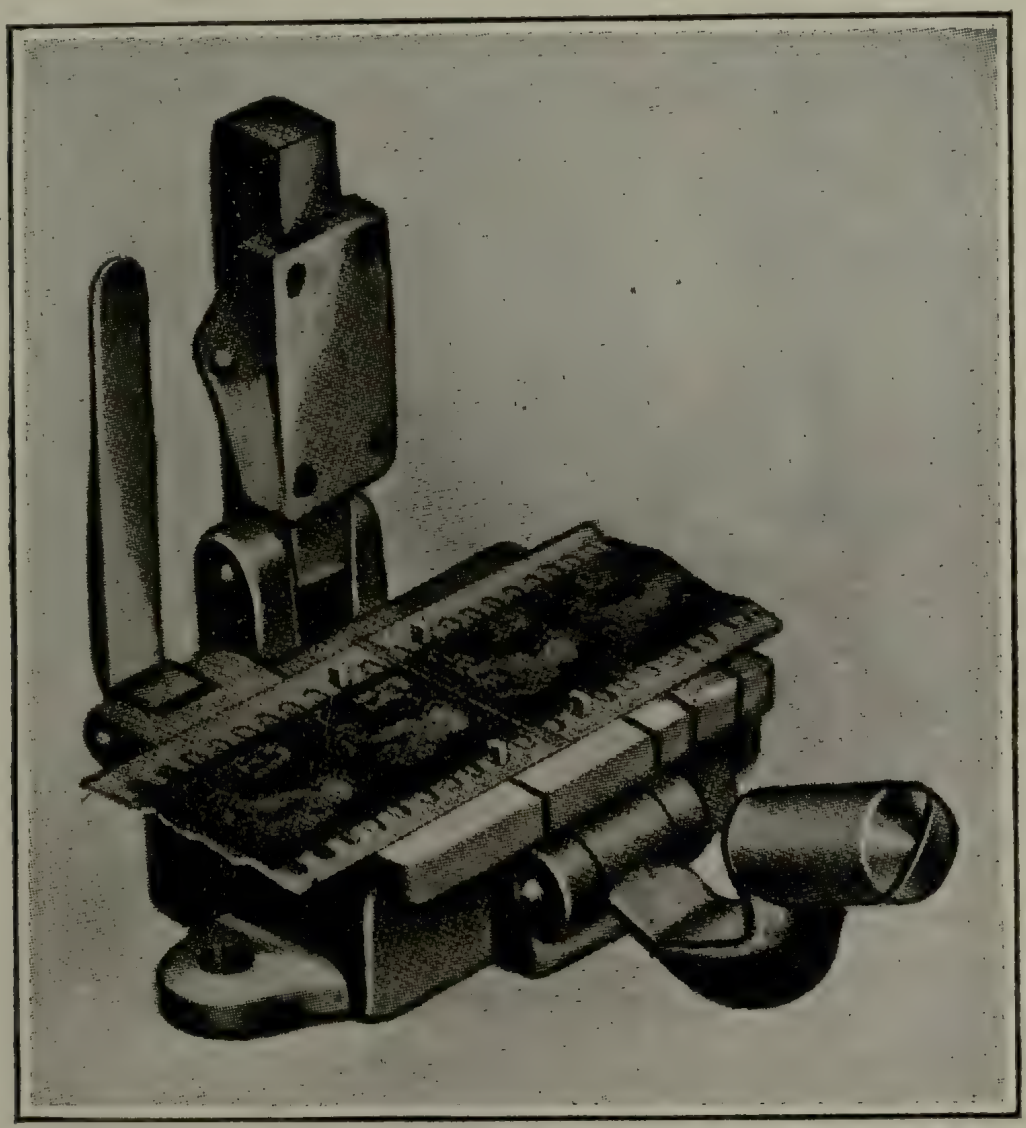
number of repairs must be counted on, especially when it is borne in mind that the long celluloid



Universal splicing machine, showing how a piece of film is held in place and the straight-edge applied so as to clean just the right amount of film for the splice.

ribbon is composed of many short lengths of film cemented together; and due to the heat, friction,

bending, stressing and other factors rising out of projection, these joints often give way and the film parts in the course of handling.



Universal splicing machine, with one end of film laid over the other, ready to have the cement applied and the press closed for cementing.

Still, there is nothing formidable about cementing or joining film. A little care is required and the work must be neatly done, since an improperly made patch

shows up on the screen, let alone coming undone with all the inconvenience which that entails. As shown in the accompanying illustration, the film should be cut immediately on the frame line, while the other end is cut about one-eighth inch beyond the frame line. The latter film is then taken in hand, and the one-eighth inch of extra picture or frame is carefully moistened and the emulsion scraped off clean with a safety-razor blade. Remember, a good patch cannot be obtained unless all the emulsion is removed and the celluloid base is bared.

Some form of splicing machine or film press is a positive necessity, for the cementing operation partakes somewhat of the nature of a weld, since the film cement dissolves the celluloid of both pieces to be joined and virtually causes one to flow into the other, so to speak. Therefore, unless a firm pressure is applied the joint cannot be satisfactory.

The author has found the Universal type of film splicing machine most convenient for all-round work on standard sized film. With this machine, which is shown in the accompanying illustration, the film is first cut at the left, about 3/32 to 1/8 inch to the right of the frame line. Then it is located on the machine as shown, emulsion side up, and the straight edge is brought parallel with and on the left border of the frame line. Then the previously slightly moistened emulsion from the portion of the film protruding from the straight-edge as illustrated, can be safely removed with a safety-razor blade, with a square edge scraper, or better still, with a special steel wire brush made for the purpose, which safe-

The essentials in mending film, including splicing press, bottle of cement, plate glass rest for cutting film, safety razor blade, and pair of scissors.

guards against undercutting. This done, the film thus prepared is placed on the machine as shown in the second illustration, holding it there by bringing the hinged arm down on it. The other end of film is then cut through at the middle of frame line. Film cement is now applied on the bared portion of the first end of the film. The pins of the cementing machine serve to hold the two film ends in place so that the joint may be properly made with the sprocket holes maintaining the proper step after the splice has been brought about. So, after applying the cement, the main hinged member is brought down and locked in place. If, after three to five seconds, the machine is opened, the surplus cement, still in semi-fluid condition, may be removed by gentle rubbing with a clean piece of cheese cloth. Quick movements, from applying the cement to and including the application of pressure, are recommended, as the adhesive quality of partly hardened cement is very poor. This work requires considerable practice before dexterity is gained. In fact, in the motion picture industry girls are trained for just this kind of work.

Unless care is exercised in making the splices, misframes or bad spots are the result. A dirty patch shows up big on the screen. Misframes are detected when the framing of the projector is thrown out of gear, and it becomes necessary for the operator to reframe the image so that the picture just fills the screen nicely, instead of having the bottom of one frame and the top of the next showing on the screen at the same time.

The Matter of True Reels

What we have learned about rented film also applies to the reels on which the film is wound. The usual reels that come with film are apt to be the victims of pretty rough wear and handling, with the result that they are bent out of shape and are anything else but true. So the careful projectionist never fails to transfer the film from the exchange reels to his own reels, which he keeps in perfect shape and absolutely true and clean. This is but another precaution that makes for perfect projection. It requires but little time and effort to carry out, and is well worth the bother. Nothing can give rise to more trouble for so little cause than a slightly bent reel. The film in that event catches on the bent portion and either fails properly to unwind from the top reel, or climbs on the rim of the damaged take-up reel until it causes trouble in the projection. Obviously, when the films have been used and are to be returned to the exchange, they can be wound back on the exchange reels and the projectionist's own reels returned to their place, ready to receive a fresh batch of films.

The foregoing-mentioned practice takes time and trouble, true; but it will be found to pay in the long run. Unfortunately, it is not common practice.

Care of the Film Between Projections

Film should always be kept in a cool, damp place when not being used in the projector. It is a fact that heat and a dry atmosphere destroy the pliability

of the celluloid base of the film, making it brittle and weakening the strength of the joints. In fact, the extreme heat generated in some of the modern high-power projectors, such as those used in our largesst picture houses, with throws of 200 feet and over, is responsible for weakening the films which are passed through such machines. The truth of the matter is that certain film companies have been accused of producing film stock of poorer quality during recent years; but that is not the case. The films are often exposed to such intense heat in the larger projectors that they are virtually baked and their pliability destroyed. Such films then become brittle and are liable to break and tear at the slightest application of undue strain. However, as far as the amateur projectors are concerned, there is no danger of this, since the light employed is not sufficiently powerful and hot to injure the film. These facts are only mentioned by way of general information.

An air-tight humidor is a very desirable piece of equipment for the amateur projectionist who has some regard for his films and those entrusted to his care. A blotter moistened with a solution of glycerine, camphor, eucalyptol and menthol, placed in the film container, is often of value in improving the condition of a hard, brittle film. The reason for this is that the celluloid of the usual film contains what is known as a "solvent," which gives it the pliable characteristic. The solvent of most films is camphor, which accounts for the strong camphor smell of some celluloids. Again, a blotter dampened with water is apt to prove of value in reviving the pliability of

a film. But it is well to exercise some care when using water near films, for if the film is subjected to excessive moisture, the emulsion soon softens and even runs off the celluloid base.

So much for the film. Now when it comes to the projector, it is well to exercise extreme neatness and care. The difference between good projection and poor projection is largely a matter of attending to the many little details which, while seemingly insignificant if considered alone, in the aggregate go to make perfect projection.

First of all, the projector should always be kept clean, which is an easy task if done at regular intervals and preferably before showing pictures. So much oil, grease and graphite are employed to lubricate the usual projector that it is quite to be expected that oil and grease find their way to the film-handling members, such as the sprockets, idlers and gate. While the projector should be oiled before each exhibition, if possible, it should certainly be wiped clean of excess oil so that the film will not be soiled. The presence of oil in the path of film generally results in the accumulation of dust which, sooner or later, marks the film and results in dirty projection. Any oil that should accidently fall on film may be removed with a soft, lintless cloth, whether on the emulsion or celluloid side.

Housekeeping Around the Projector

A common source of trouble is the accumulation of tiny hairs or wooly substance in the aperture, which make their presence known by showing about the

frame of the projected pictures. These can be avoided by cleaning out the aperture with a soft, lintless cloth before and after each reel is projected.

Film, of course, is subject to wear in its travel through the projector; and much wear results in the accumulation of considerable dirt in the sprockets, between the sprocket teeth. In order to clean this dirt off the sprockets, a stiff tooth-brush or typewriter brush should be used as frequently as the accumulation is noticed. The steady accumulation of such dirt, if not checked in time, causes the film to climb with a noticeable unsteadiness on the screen, results in the loss of loop, and even causes injury to the delicate sprocket holes.

Dirt and dust are the arch enemies of the film throughout its career, or from the time when it is made in the film factory until it is loaded into the camera, exposed, developed, washed, dried, shipped and projected. The projectionist cannot exercise too much care in cleaning out his projector as frequently as possible. The entire film track should be kept free of all dirt accumulations. The idlers or rollers, on which the film rests, should be examined to see that they turn freely, especially if the emulsion or dull side of the film is in contact with them. Film is delicate, and the friction produced by passing over the stationary face of a roller that is not rolling is sufficient to produce severe scratches. The same may be said about the rollers employed in the magazine openings for fire guard. These should revolve freely. Then again, the felt or velvet pads, which are also used for fire guards, should be frequently examined

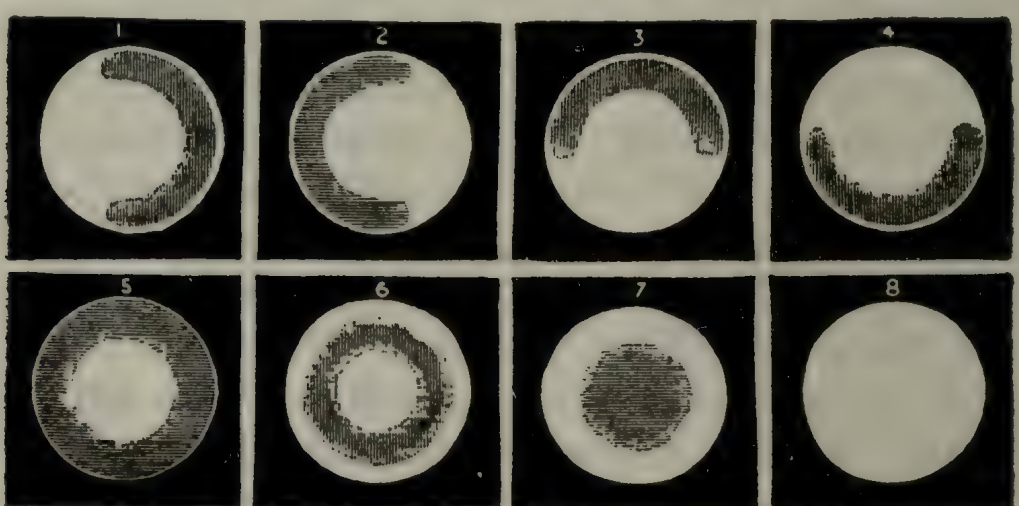
in order to brush off and clean off the accumulations of dust and dirt and even tiny film particles which are apt to cause film scratches.

Trouble is often experienced with new film being projected for the first few times. A hard material collects on the tension springs and causes a loud, pounding noise. In such event the machine should be immediately stopped, the gate opened and the accumulation removed from the tension shoe with the fingernail or by means of a slightly moist rag. The use of a knife or other sharp metal edge should be avoided, for this practice is apt to scratch the highly polished surfaces of the projector and cause subsequent trouble.

The difficulty just mentioned may be avoided by waxing the film before it is projected, so claim some authorities. In fact, there are special machines on the market which wax a film in short order, thus ensuring better projection and longer life, so it is said. Film manufacturers often wax their films before shipping them to the exchanges, although an occasional news reel or other urgent release comes through unwaxed. A simple way of applying wax is to hold a cake of paraffin against either edge of the film during rewinding. Another expedient is to apply a little paraffin on the polished metal surfaces of the tension springs and gate of the projector. A machine, designed by M. H. Schoenbaum of New York, is said not only to cause new or "green" film to run smoothly through the projector without wax, but also to clean both sides of the film, when old, in one operation.

The Adjustment of the Light

Successful results in projection depend largely upon the correct adjustment of the lamp, which must throw a brilliantly illuminated circle or rectangle upon the screen. After the objective or lens



Circles showing illumination on the screen when the lamp is improperly adjusted and when it is correctly adjusted.

is focused, as will be evidenced by a sharp clear image on the screen, the adjustment of the lamp may be studied. In the case of some projectors which include a stereopticon attachment, the slide and slide holder should be removed so as to project a full circle, as shown in the accompanying illustrations. If the light is centered and the lamp correctly adjusted this circle will be clean and entirely free from coloration or shadows. However, if the effects shown in Figs. 1 and 2 appear, the operator must know that the source of illumination needs to be properly adjusted laterally, being too far to the

right or the left. Figs. 3 and 4 show the effects when the light is too high or too low. Figs. 5, 6 and 7 represent the effect of having the light too near or too far from the condenser. Fig. 8 shows the light in the correct position, the field being entirely clear. Of course, if the rectangular field of the motion picture projector is being used for these tests, the same results will be more or less noted and can accordingly be corrected.

The Screen That Receives the Pictures

The screen may be anything from a white wall or ceiling used in conjunction with the projection of films with a portable projector, in which case the operator does not wish to be burdened with the additional weight and bulk of a screen, or one of the numerous screens now available. For those who desire to make their own screens, the author suggests the following:

Mix boiling water and whiting until the mixture is of a creamy consistency. To one gallon of this mixture add one pint of fluid glue and one pint of glycerine. Paint on the stretched canvas with a wide brush and lay it on smoothly. When dry, the canvas can be rolled.

The same preparation may be used for painting a screen on a wall, where the installation is a permanent one. The author has made good use of aluminum paint which, if anything, produces better results than the plain white surface just mentioned. Aluminum paint has excellent reflecting qualities, and for that reason it is to be preferred to white

surfaces. The greater the reflecting qualities of the screen, the brighter the pictures with a given amount of light.

It is of interest to note that the eye sees a picture on the screen not by the light which strikes the screen, but by the light which the screen reflects to the eye. If we imagine a perfectly black screen, one which reflects no light at all—we see at once that no matter how strong the beam we project on the screen we will obtain no picture at all. Screens used in practice vary in reflection factor; that is, in their power to reflect light, through very wide limits; hence it is obviously necessary to consider the reflection factor of different screens when discussing screen intensities. Nor is it correct to assume that the screen which reflects the highest percentage of light striking it is necessarily the best screen to use, for the manner in which the reflected light is distributed is also a factor which affects the brightness of the picture. For example, it is possible to conceive of a screen which reflects a very large proportion of the light striking it, yet which, due to the fact that it distributes the reflected light far out to the sides, is actually less satisfactory than one which reflects a lower percentage of the light striking it but which confines its reflected light within useful angles.

From the standpoint of their reflection characteristics, screens in common use may be divided into two classes:

Diffuse reflecting screens;
Spread reflecting screens.

Of the first class, white cloth screens and plaster screen are typical. A white cloth screen when clean can be made to reflect as high as 70 to 75 per cent. of the light which strikes it; and a plaster screen 80 to 88 per cent. Please note, however, that the light is reflected at wide angles. Such screens are well adapted to theatres in which the position of the seats with respect to the screen is such that the picture must be viewed at relatively large angles, for no matter from what angle the screen is viewed, the brightness is the same because of the way in which the light is reflected.

Aluminumized screens and ground-mirror screens are examples of the spread reflecting class. A clean aluminumized screen can be designed to reflect about 60 to 65 per cent. of the light striking it and will confine the reflected light within an angle of approximately 30 degrees. Ground-mirror screens when clean can be made to reflect approximately 80 to 90 per cent. of the light and confine the light within about 30 degrees. Such screens are well adapted to theatres in which the seats are so arranged that the picture does not have to be viewed at large angles.

The author is indebted to Mr. R. P. Burrows of the Society of Motion Picture Engineers for these valuable facts regarding screens. That authority emphasizes the point that the reflection factors already mentioned assume a clean reflecting surface; a very slight accumulation of dust can reduce the screen brightness very materially. He believes that with a schedule of regular and frequent cleaning.

theatre managements can in many cases increase their screen brightness by fully 50 per cent. of their present average values if they desire to do so.

Thus, it is seen that the intensity of the beam projected determines only relatively the brightness of the picture.

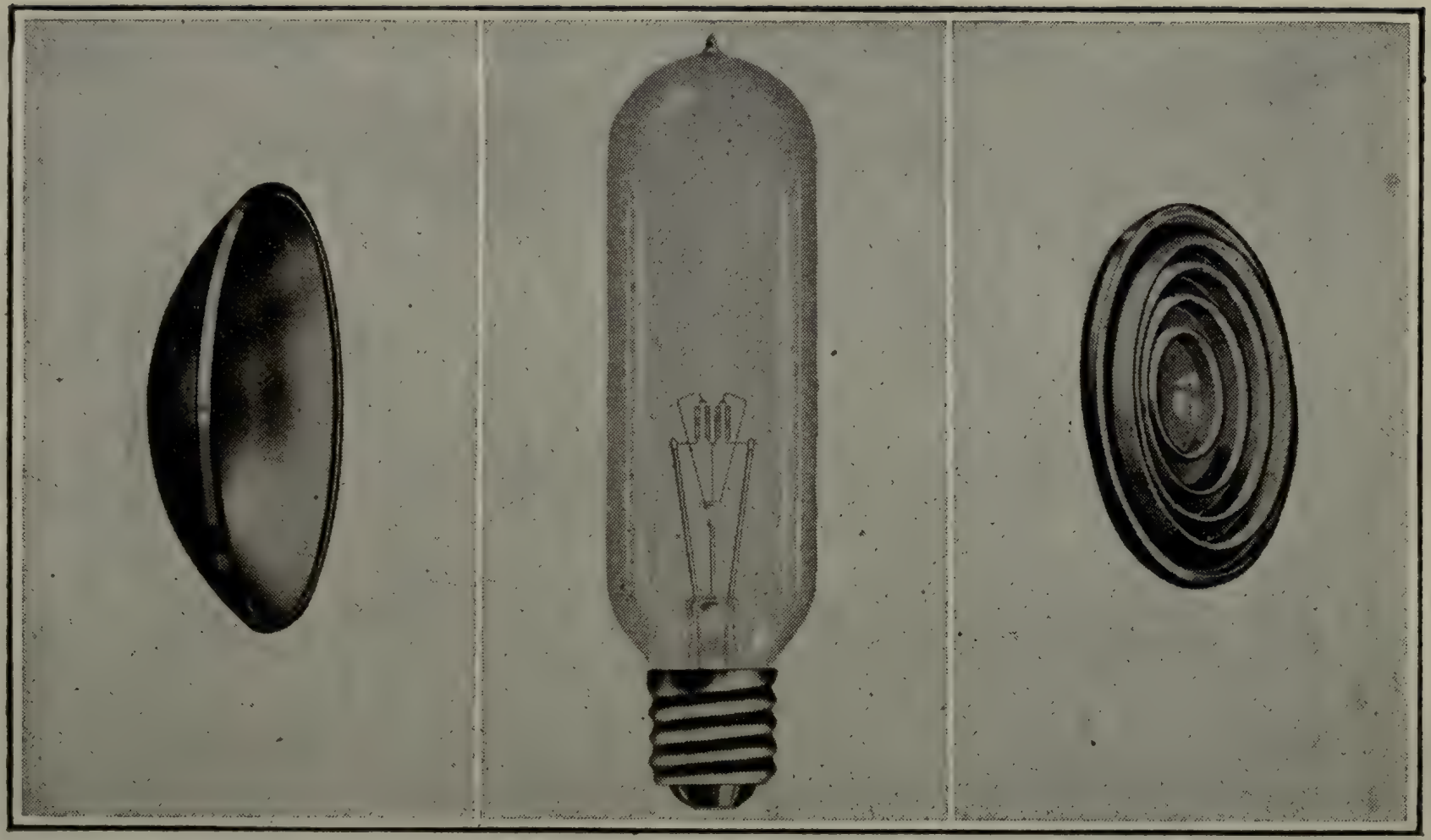
Uniformity of screen illumination is another factor which must be considered in connection with screen intensities. It is not uncommon to find screens upon which the intensity near the center is several times the intensity near the edges of the picture, or where the intensity on one-half of the screen is much higher than upon the other half. When this condition of non-uniformity obtains, certain portions of the picture are, of course, brighter than others, and while the eye cannot readily detect small differences in brightness the fact remains that to say a screen is illuminated to a certain average intensity is not definite when a wide difference exists between minimum, average and maximum intensity values. Good projection requires a screen intensity approaching uniformity, and the nearer the intensities at different points come to being equal the better will be the projection from this standpoint. The uniformity of intensity at different points on the screen is affected by the condenser design, steadiness of the light, and by refinement in focusing adjustment.

Another factor which we must consider is extraneous light. Obviously a higher screen intensity is required in a theatre in which daylight is allowed to enter or where lights are kept burning at all times than in one where all the light comes only from the

projection apparatus. The effect of extraneous light is to decrease the contrast between the high lights and the low lights on the screen. If for example the intensity of the beam in a low light of the film is, say, 1/50 of a foot-candle at the screen, and in high light the intensity is, say 2-foot-candles, the contrast is 1 to 100. If upon the screen image is now superimposed an intensity of 1/10 of a foot-candle, due to extraneous light, the contrast becomes approximately 1 to 17. From this it is apparent that even a very low intensity of extraneous light calls for considerable increase in screen intensity if good contrast is to be secured.

For the past few years the author has made use of a handy little screen put out by the Pathescope Company of America in conjunction with the Pathescope projector. This screen has an aluminum surface and produces brilliant pictures with a minimum of illumination. Furthermore, it can be rolled up for convenient storage or portability.

There are several kinds of special screen now in use, but these are of perhaps more interest to the professional than the amateur projectionist. Some of these screens depend upon certain metal or even metallized fibres for their effective reflecting properties, while others depend on corrugation or special shapes in order to eliminate distortion and even produce a stereoscopic effect. Thus there is the Trans-Lux screen, which is a translucent, nearly indestructible composition, unaffected by weather conditions and not easily inflammable. The surface of the screen is very finely corrugated, which, in combination with



Elements of the incandescent lamp system of illumination employed in most amateur projectors, consisting of a carefully formed mirror, the high efficient gas-filled incandescent lamp, and the condenser.

the character of the material, produces what is claimed to be a perfect projection surface that will hold the light without harsh reflections and that results in a bright, clear and exceptionally plastic picture. This screen is made in two varieties, for front and for rear projection. The front projection screen is made from the same material as the rear projection screen just described, but by a special process is rendered opaque.

Now the rear projection screen is especially designed for use in daylight, although it can be used under any conditions of either daylight, artificial light or darkness. This screen seems to be well adapted for use in schools, churches, clubs and industrial plants, offices and showrooms, where it is desired to exhibit either stationary or moving pictures for educational, business or other purposes during the hours of daylight. Incidentally, this screen can be rolled up for portable purposes. When using translucent screens anastigmat projection lenses are recommended.

Still another screen is the Glifograph, which is the result of twelve years of scientific experimental research by Dr. Louis Pech, professor of physiology at the University of Montpellier, France. In brief, it is a concave screen made up of hyperboloid surfaces, accurately calculated, showing the pictures projected on it with the same natural aspect as when viewed direct by the human eye. This screen is one of several others that have for their object the elimination of the distortion that is so evident when a picture on a flat screen is viewed from off center.

The surface of the Glifograph screen is an extremely finely woven gummed canvas, especially impregnated, reinforced and cured, with rubber backing, which, by reason of lacing on the frame, insures at all times a perfect surface. This surface is quite durable and may be washed when it becomes soiled. It is claimed that with this screen the light is evenly spread over the entire area, yet there is no reflected glare.

The Glifograph screen, being a concave hyberbolic screen, the pictures projected on it will appear with the same natural aspect as when viewed direct by the human eye. The third dimensional effect, so noticeable in pictures shown on this screen, is explained by Dr. Pech in this way:

If we examine an object approaching progressively to an observing eye, the object occupies a part of the visual field so much greater as it is nearer. The picture of this object on the retina is greater in proportion to the nearness, and, at the same time, the marginal distortion will be greater in proportion to the nearness. Having been accustomed to these variations of distortion since the beginning of our life, we have been in this way educated to locate the various objects far or near in the atmosphere, according to the degree of the more or less strong sensation of distortion.

The Glifograph screen, which is now employed in several leading picture theatres, is so constructed that it recreates the natural marginal distortions very much stronger when the object is near, the spectator receiving the same impression as in nature,

and, instead of locating all the objects on the same plane, he locates them on various planes in the depth.

It is well to have any screen framed, whenever possible. That is to say, the reflecting surface of the screen should be surrounded by a black or other non-reflecting border which sharply delineates the screen picture. Just as any other picture requires a frame in order to set it off to the best advantage, so does a projected picture require a suitable frame. In the case of most manufactured screens, a dull or matt black border surrounds the reflecting area. The projector is so adjusted that its rectangle of light fills the reflecting area and overlaps just a trifle into the border on the four sides. The object of the border is also to have a sharp, clean-cut edge to the projected picture, and one which is absolutely immobile. If a projector is not absolutely rock-steady it must have a slight up-and-down motion in its projected picture which is noticeable if a framed screen is not employed. With the non-reflecting border on the screen, however, the picture is held rigidly in place.

And Now for the Pictures

Everything having been prepared and ready for action, the film is now threaded into the ways and byways of the projector. The reel of film is placed in the top magazine or, in the case of non-inflammable film, on the top arm (no magazine being required for such film) in such a manner that the emulsion side will be toward the light at the aperture. The sprocket teeth and sprocket holes must mesh per-

fectly wherever they engage, and the operator should exercise the greatest care in this respect. It is well to make sure of the perfect engagement of teeth and holes at each point before proceeding to the next step in the threading of the film. The idlers should only be pushed into place when the sprocket teeth and sprocket holes are in perfect mesh. Ample large upper and lower loops should be made, but the operator should not go to either extreme. If the loops are too large, they cause the film to strike the housing or other parts of the machine, perhaps resulting in scratches. Also, exaggerated loops sometimes make an unpleasant noise while the machine is in operation. If the loops are too small, on the other hand, the film is apt to be subjected to undue tension, causing the sprocket holes to be torn or even the film to tear apart.

One feature of projection that requires some care is the tension on the take-up reel. If the tension is too strong it is apt to strain or even tear the sprocket holes, and cause the film to part at weak patches. On the other hand, if the take-up is too loose, the film may not wind up on the take-up reel, and, instead, it may pile up in the machine with serious consequences. The operator should keep an eye on the take-up reel during actual operations, to make certain that the bottom reel is taking up properly.

After the film has been threaded and the operator is ready to start, it is well to give the projector just a few turns, in order to make certain that everything is properly adjusted and functioning correctly. This

is done without the light turned on, in cases where the machine is not provided with an automatic light shutter or fire shutter. Then, when everything appears in tip-top shape, the projector is started slowly and then speeded up to normal, or one foot per second. Then the light is thrown on. It is presumed that the machine has already been focused and properly framed, but if necessary the final touches can be made with regard to focusing and framing while the machine is in operation. It goes without saying that such adjustments are not pleasing when viewed on the screen, and the efficient operator always makes all his adjustments before he starts his show.

If anything goes wrong with the machine while it is in operation, it is well to stop it immediately. No chances should be taken with an inoperative take-up, for instance, which is piling up the film on the floor, even if the interruption of the show is apt to prove a keen disappointment. Loose inflammable film is a potential source of danger and should be avoided. If a break should occur during projection, the loose ends may be fastened together temporarily by the use of a paper clip. Clips do not damage the film and there is no danger to the inspector's hands during the rewinding operations. When pins are used there is danger of the inspector's hands being seriously injured, since inspection work consists of passing the film through the hands in order to detect breaks, sprocket hole damage, loose patches, and so on, as already described. After clipping the film together, the projector can be restarted.

Rewinding the Films After the Run

Rewinding may be done in a variety of ways, but it is a very necessary operation with most machines. There have been attempts made at projectors which require no rewinding, because they rely on some scheme or other for taking the film from either end at will. But with the usual run of projectors the film that has been run through has the tail end first and the beginning at the inside end of the reel, and it must therefore be rewound to bring it back into its original and proper order.

With many of the amateur and semi-professional projectors in general use, the rewinding may be done on the machine itself, either by hand-cranking or by motor. Of course, where the rewinding is done by motor, a great deal of time is saved. The most desirable form of rewinding on the projector itself is where provision is made for rewinding by motor without operating all the projector mechanism.

In some instances it is desirable to rewind as an independent operation, in which case one of the rewinding stands in general use is used. The film being rewound should be guided slowly and accurately into the reel, care being exercised that the film does not climb over the side of same. How much tension to apply on the film being rewound is a problem, for if too much tension is applied, the film may be badly scratched, and if too little is applied, the film bulks up and more than fills the reel. The operator should never attempt to tighten a reel by pulling on the end of the film, for this practice causes every dirt

particle to dig into the soft emulsion, causing "rain" or streaks. It is far better to rewind the film again, and even two or three times if necessary, until the desired degree of tight rewinding is obtained without injury.

When returning reels to exchanges it is not necessary to rewind the films if they are being returned on the original reels. If, however, they are to be returned on the exchange reels, after they have been shown on the projector's reels, it is obviously necessary to rewind anyway. Exchanges generally rewind films and inspect them at the same time, after they are returned by a subscriber or exhibitor, hence they would as soon not have the films rewound by the rentor.

For the protection of films, it is common practice to place reel bands, or strips of tough paper, about the film, holding it in place by means of a rubber band. These reel bands serve to protect the outer turns of the film.

It seems necessary here to say a few words regarding the care of rented films. The exchange system, whereby anyone owning a projector can rent certain reels for one or more entertainments, makes possible the wonderful variety of our motion picture shows, amateur and professional alike. Were it necessary for the projectionist to own his own films, it stands to reason that he would have to show more or less the same films over and over again. But by securing his reels from an exchange, which has thousands upon thousands of reels to rent, he can have different subjects every week or every day,

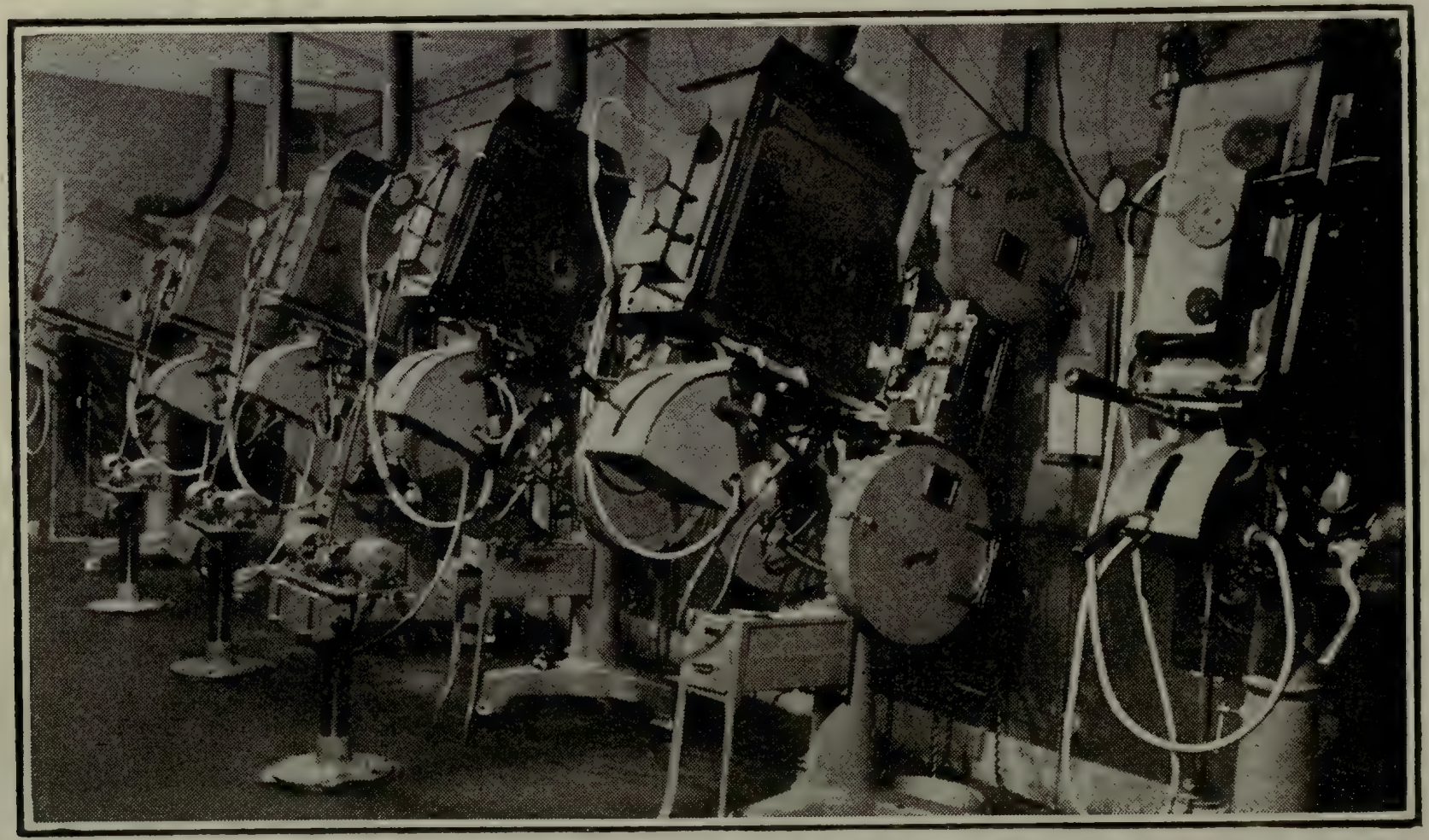
with all the interest and satisfaction that such practice entails.

The rented reels, be it remembered, are not the property of the projectionist. They are entrusted to his care for a given length of time and in consideration of a certain rental charge. The exchange places the projectionist on an honor basis, and expects him to respect and care for the property rights of the exchange. The projectionist is bound to take as good care as he knows how of the reels entrusted to him, making such repairs as may be necessary, and to return the reels in good condition to the exchange so that they may be passed on to the next rentor, and so on.

Care of Projector Lenses

The shipping of films is subject to certain restrictions and rules, if they are of the inflammable kind. Non-inflammable film can be shipped by mail or any other way without restrictions of any kind. The regular celluloid film must be shipped in accordance with Interstate Commerce Commission specifications, which can be learned from any express or forwarding company. Shipping cases marked "ICC-32" are approved by the commission. The package must be marked "Motion Picture Film" in large letters, and must carry the new yellow caution label every time it is shipped. If an old container is being used, care should be exercised to make sure that all the previous addresses are removed or erased, and only the new one remains.

Before bringing to a close this chapter on projec-



Battery of projectors and stereopticons in the projection booth of a large motion picture theatre. The arc lamps of these powerful projectors are automatically fed and regulated by the little electric motor controls shown in the lower left-hand corner.

tion, it is well to say something regarding the care of lenses. For this information the author is again grateful to the Bausch & Lomb Optical Company.

To secure the best results the lenses must be kept perfectly clean and should be protected as far as possible from dust and finger marks.

A soft, oft-washed linen cloth is the best appliance for cleaning lenses.

Do not use any kind of polishing material, alcohol or other solvent on a lens.

To remove finger marks breathe upon the surface and wipe lightly, with a circular movement.

A lens should not be exposed to the heat of the sun or of steam coil pipes, and should not be allowed to remain for a long time in a damp place.

The condensers can be quickly removed from their mountings, cleaned or replaced, and care should be exercised to place them in the correct position.

The breakage of condensers is due to unequal expansion or contraction caused by sudden extreme changes in temperature. It is obvious, therefore, that they should not be removed from the lantern while heated, or exposed to cold draughts. This has more to do with machines using arc lamps, with all the heat which such illumination entails.

If the lantern has been for some time in a cool or damp place, moisture will collect on the lens surfaces when the heat of the arc reaches them. As soon as the parts are uniformly heated no more moisture will collect. It is well to bear this in mind and see that the lens surfaces are free from moisture before beginning to operate the lantern.

Chapter VIII.

THE ANIMATED ALBUM: FILMS OF FAMILY, FRIENDS AND PETS

IT is well to be prepared when about to make motion pictures of any kind. Film costs money—a great deal of money; and it is this item of heavy costs that no doubt causes one to think more than once before "shooting" any given subject. Is the subject worth the film involved? Will it be interesting on the screen? Is it sufficiently animated? How does it fit in with other scenes of the same category? Is the background satisfactory? These and many other questions generally flash through the mind of the careful motion-picture amateur, and as a direct result said amateur is apt to develop a case of what the author calls "camera paralysis," for want of a better name.

At any rate, it is a fact that the presence of a camera only too often drives away those many brilliant ideas which have been formulated and gathered together in anticipation of the coming filming operations.

Hence it is well to have something to fall back on—some scheme of action which may be taken up when one's own ideas vanish like thin smoke before the stern gaze of the motion-picture camera lens. If possible, too, the scheme should be set down on paper, scene by scene.

A Question of Personal Vanity

Make no mistake about it: we are a proud people. Films of pets and sports and favorite haunts are interesting enough to all of us; but above all else we like to see ourselves on the screen. We all crave to look ourselves over; or, otherwise said, to see how we appear to the other man or woman. It is decidedly a treat to see one's self on the screen. Truly, it is almost supernatural when experienced for the first time.

At any rate, one of the essentials of a good film for family entertainment and permanent use is to have plenty of cinematographic studies of the various members of the family.

Now, motion pictures differ from snapshots and "still" camera pictures in that they are animated. Merely to make a motion picture of a person means nothing unless that person is doing something or other. If that person is merely standing still or sitting still, it is but a waste of good money to make motion pictures. In fact, in that event a snapshot or "still" would be just as effective.

So in posing persons for motion pictures, the cameraman should always find something for them to do. Of course, when photographing a single person this is rather difficult. In such a case the person can be shown telephoning, which offers ample opportunity for a frown, a couple of smiles, consternation, irritation, and whatnot in the gamut of facial expressions. Or, what is a different version of the same idea, the person can be talking to someone who is either in or

out of the picture. But the person must be shown doing something in order that the picture may be interesting on the screen. Remember, it requires a good deal of action to make a true motion picture. The mere cranking of the camera doesn't produce action unless there is action in the subject.

In the instance of children, especially infants, it is not difficult to obtain action without encouragement of any sort. Children are generally without self-consciousness when posing for motion pictures; and after the first curiosity has worn off they are apt to play without paying further attention to the camera. That is the case with most children, but there are exceptions which must be treated tactfully.

With timid children it is often impossible to make a close-up picture. In this case it often becomes necessary to hide the camera behind some suitable object, such as a bush or fence if outdoors, or behind a piece of furniture if indoors, and try to get up as close to the child as possible. But then again the camera, in nine cases out of ten, makes a characteristic noise as it is cranked and the timid child is very quick to detect what is going on, with further trouble and plenty of it for the persistent cameraman. The only alternative, then, is to place the camera some distance away, out of sight if necessary, and use a long-focus lens. The author has found a six-inch lens ideal for this purpose. In the case of a timid child he made a 400-foot film largely with the aid of the six-inch lens, the camera being about forty to sixty feet away or more for practically every scene.

Close-Ups—The Prime Requisite

By pictures of individuals, we have in mind close-ups, with the camera not more than ten feet away, and preferably nearer. The criticism we have to register regarding many amateur films is that their subjects are too far away—too small on the screen. With many amateur projectors and amateur films the degree of sharpness on the screen is such that persons fifteen feet away cannot be distinguished with ease; at any rate, their facial expressions are none too clear. Of course, this is due in large measure to the fact that amateur negatives are not always of the best photographic quality, and the screen results, accordingly, leave something to be desired in the way of crystal-like clearness.

So to be on the safe side, it is always best to make close-ups of individuals, with the camera as close as six feet wherever permissible. At such a distance every little facial expression can be registered successfully and reproduced on the screen. Such pictures are of the most intimate character and are certain to please the individuals thus featured.

From the camera operating standpoint, it must be remembered that in these close-ups the field of the picture is quite limited, being perhaps not more than three feet high by four feet wide. Great care must be exercised that the person or persons appearing in these close-up scenes are entirely in the picture—it would not do to chop off the gentleman's scalp or the lady's left ear! The action must accordingly be limited so that there is no danger of going out of the

picture. The subject should be carefully centered and focused by looking through the peephole of the camera, since finders are no longer accurate at such close range, and the focus becomes quite shallow; so much so, in fact, that a foot or two out of the way on one's guesswork is apt to mean a fuzzy picture, if the operator sets the focus by guessing at the distance.

In the case of fixed-focus cameras, such close-ups can hardly be attempted, except when working in the brightest summer sun with an aperture of f:16. The fixed-focus lenses are generally set at 15 feet or 25 feet, and by referring to a chart of their hyperfocal distances at various openings it becomes quite evident just how near one can come to the subject and still have a sharp picture. In the case of one of these fixed focus cameras, the old model Pathescope of French manufacture, the hyperfocal distance is 4 feet at f:16.

Now close-ups, while the very essence of all animated album films, are by no means everything. A film would be pretty monotonous if it comprised nothing but close-up studies. And as already mentioned, there can be only limited action in the close-ups—just sufficient animation to make a motion picture.

Filming the Children

Children, strange to say, are easier to film than grown-ups, as a general thing. Here and there one may come across a child who is disinterested and unwilling and—well, we might as well say it—stupid. The author had such an experience with the child of

a well-known woman. Over 300 feet of film was cranked away, and in that entire footage there was nothing really worth while. The child simply wouldn't co-operate; yet successful filming is largely a matter of co-operation, or at least a complete lack of self-consciousness in the case of an infant. When dealing with infants there is no use planning any given action; the infant does the planning for the cameraman. The infant may be shown with its mother and father, eating or drinking its bottle, playing, and laughing and crying. There is usually plenty of action without encouragement of any kind.

In the case of older children, one finds the task rather easy if the general line of action is only suggested to them. Aside from close-up studies as already mentioned, the children can be shown at play, with their pets, picking flowers, and so on.

But the author's experience has been that it is best to work a little story into the film, no matter how simple and inconsequential it may be. One that proves very successful is to have the father reading his paper. The child or children, perceiving their father from some distance, believe him to be asleep. The father surmises the plot and feigns sleep. The child or children creep up on the father from behind, and tickle him with a weed. The father, still keeping up the deception, makes several passes at the weed but fails to get it. The child or children believe the father is being fooled and creep up closer. Suddenly the father, with a quick swing of his arm, catches one of the little arms and captures the mischief maker—or both if there are two.

Such a little plot as this makes good action for 150 to 200 feet of standard film, depending on how much detail is included. It offers excellent opportunities for close-up studies of the father and the child or children. It combines close-ups with long shots. Best of all, however, it gives the cameraman a definite plan of action and helps to cure "camera paralysis." The children and the adults fall in with the spirit of photoplay acting, and positively love it.

Obviously, other stories can be made up for the same purpose. Mother can be shown making a pie, which she places on the window sill. The mischievous children can be shown stealing the pie and replacing it with a pie plate filled with mud. Mother is astonished to find the mud when she comes to look at her pie. She plans to fool the children. That afternoon, when they sit down at the table for tea, mother serves them the mud pie and expresses amazement when they refuse to eat it. She makes believe she does not know their trick. Then, when the children confess and shed a few tears, mother laughs at their little prank and produces another pie which she had in reserve.

Many other such stories suggest themselves. But remember, always prepare your story in advance. It is the most difficult thing in cinematography to attempt to make a film with extemporaneous ideas. Furthermore, such a procedure is only too often a failure, since there is apt to be a complete lack of continuity which is so vital to a good film presentation.

If a story is not desired, then the children can be

shown as already stated in a number of studies, both close-ups and long shots. During the summer they can be shown playing in the sand or dirt, playing ball, playing in water or swimming, rollicking with their dogs or other pets, and so on. A most effective picture is the feeding of chickens. Such a picture always proves replete with animation, since the chickens gather about the children with the feed.

It may be well to show the children the camera before making the picture. The author has found it good policy to open up the camera and explain its mysteries in words of one syllable to the children about to be filmed. In this manner, when the filming is under way the camera is no longer an attraction any more than a tree, fence, suit-case, chair or whatnot.

Filming the Adults

When it comes to the adults, it is generally more difficult to find something for them to do. Why, of course, the adults have all sorts of plans as to what they are going to do when the cameraman arrives on the scene. There will be a burlesque on Mary Pickford's latest success, by sister, who has longed to get into the "movies"; her beau, a staunch admirer of Charlie Chaplin, will emulate that noted comedian's antics; father believes himself a second Douglas Fairbanks—without the opportunity, naturally—and here is a chance to prove his claim; mother longs for a chance to display her highly emotional acting; and the little tots plan to ring in the Teddy bears, cats, dogs, chickens, birds, toys, skates, sleds, wagons,

and all the little playmates they have ever known.

Then when the cameraman arrives on the scene, all those brilliant ideas and hopes vanish away. Time and again this proves to be the case. Unfortunately, too, with the adults alone it is more difficult to introduce a little story because, unlike the children, they are not apt to consider a story if it does not contain a worth-while plot; and a worth-while plot is quite out of the question in a limited footage.

The only thing to do, then, is to make a number of scenes of more or less popular interest. If there are visitors present, the author has found through experience that a never-failing stunt is to have said visitors come up to the host and hostess and shake hands with them. The host and hostess stand on the porch or the terrace or elsewhere, while the guests, one by one, come up and shake hands with them. Everyone enjoys this bit of action, and it consumes anwhere from 50 to 125 feet of film, depending on the number of persons.

The host and hostess can be seen head-on, while the guests come up from one side and cross over to the other and out of the picture. Or again, the host and hostess can be shown side-on, if that makes a better picture. A pleasing effect is to have the action begin with the host and hostess seen head-on, and after the first visitor has come up and shaken hands, shift the camera to the back of the host and hostess and show the first and subsequent guests passing by the camera. This is particularly pleasing when the host and hostess are standing at the foot of a stairway and the guests pass up the stairs and by the

camera stationed on or quite near the top landing.

Another stunt that can be worked in when things lag is to show the persons drinking or eating, for that affords plenty of action. Pets always help things along; thus if the man has a horse, he can be shown riding and then standing by his horse. Dogs are a big help to any picture, especially if they are lively. If there are several young men to be filmed, they can be shown in a lively amateur boxing match or wrestling contest.

After all, this matter of filming is one of experience. The cameraman soon gets the knack of finding something to do for his subjects in each case. Likewise, he soon learns how to choose the best backgrounds and how to frame his pictures so as to produce unusual effects on the screen. One of the prettiest effects available to the amateur cameraman can be obtained by filming one or more persons walking down a path under grape arbors, or coming towards the entrance to a house in which is stationed the camera.

So far all the pictures mentioned have been outdoor subjects. The truth of the matter is that amateur filming indoors is a difficult undertaking. Unless the subject is taken near a window, where there is excellent illumination, it is almost impossible to obtain good results except at the cost of using one or two powerful arc lights. Such lights draw anywhere from 15 to 50 amperes, and in the instance of most house circuits it is impossible to draw that much current. Therefore, arc lights are generally out of the question, and indoor filming must be carried on near a well-illuminated window. The author has obtained excel-

lent results with an f:2.5 lens, and also with an f:1.9, in each case using the largest aperture. Obviously, the depth of focus with such lenses is materially cut down, and the cameraman must be very careful not to have a fuzzy picture, unless such a result is permissible on the grounds of artistic license.

In truth, it is best to limit motion pictures to outdoors. In summer the subjects are no doubt at their best, because of the warm weather which permits of absolute freedom in arranging the action. In winter, however, the lack of freedom is made up to some extent by the beautiful snow effects which may be obtained. Indeed, some of the best films are made in the winter, if due precautions are taken against the danger of static markings on the film.

And What Shall They Say?

The private film is not complete if it does not contain some of the atmosphere of the surroundings in which it has been produced—the locale, to use the technical name. So it is well for the cameraman to introduce some of this atmosphere early in his picture. The author generally starts his picture with a panorama of the grounds and house. Choosing some suitable point, elevated, if possible, a panorama view is made with some of the persons who are to be subsequently filmed, standing on the grounds in front of the house. In this manner the persons are "located," so to speak, for the subsequent action. On the screen the "sweep" shows the setting of the picture, and all the scenes that follow can be placed. The same applies with the close-up studies, which should be

introduced only after suitable long shots, so that they can be "located." There is nothing more confusing than to have a jumble of close-ups and long shots strung along into one film without continuity or relationship of any sort. The cameraman, therefore, should always bear in mind the continuity of the pictures he is making, and, to be on the safe side, even take additional scenes when he is afraid there may be missing links in the film story. This applies with more force to films which have no particular plot, representing, as they do, an assembly of pictures and nothing else.

After the film has been made and printed, it is necessary to edit it carefully. Here is where a good deal can be done in the way of making a good picture better, making a poor picture passable, or even making an excellent picture appear a failure.

Finally, we come to the matter of titles. No picture is really complete without titles of some sort. If nothing more, the picture should have at least a main title, which tells where it was taken, the date, and, if desired, the persons filmed.

Titles add a great deal to any picture. The clever amateur photoplay maker can insert humorous titles throughout his film so as to punctuate it with laughs. Or, if he desires, he can put favorite expressions into the mouths of his players, so to speak. At any rate, titles, even if they represent quite an item in the costs of picture making, are indispensable in attaining the greatest success in amateur films. A picture is unfinished and crude if it does not contain at least a main title at the very start.

Chapter IX.

PLANNING AND FILMING THE AMATEUR PHOTOPLAY

THE motion-picture screen is deceptive, lest we forget. Those of us who have great ambitions in the way of producing elaborate amateur photoplays should be reminded that there is a great deal more to the work than appears on the screen. The finished production, obviously, is the result of what has finally come through the many processes involved in photoplay production; and there may have been anywhere from 100 to 1,000 per cent. as much negative film exposed and eliminated for some reason or other in the final assembly. Certain scenes may be rehearsed a dozen times and filmed three times or more before they are finally passed on as satisfactory. In sum, photoplay making is not an easy task, whether the object is a theatrical film or an amateur production.

The True Foundation: A Good Plot

Just as in the case of house building, a photoplay cannot be undertaken without a definite plan. A general idea of what is to be filmed is not sufficient for the purpose. Because of the impracticability of filming scenes in the same order as the story, it is usually necessary to film the last scene first and the first scene last; hence the work is apt to become quite involved and confusing when dealing with an elabo-

rate photoplay calling for many different scenes. Without a more or less detailed scenario, then, the producer becomes hopelessly entangled and cannot hope for a successful production.

In producing an amateur photoplay, it is well to bear in mind the limitations. Instead of a professional director, there is the amateur director with only a general idea of how to film and assemble the scenes; for professional actors there are willing but inexperienced tyros, who cannot be called upon to play difficult rôles; and even the cameraman may be more or less inexperienced. But the fact remains that amateur photoplay producing is one of the most entertaining hobbies extant, and with a little care and patience surprisingly good results can be obtained. Indeed, many amateur photoplays produced during the past few years have proved of high standard, and in a few instances quite comparable to the productions of regular companies.

The limitations already referred to mean that the producer should select a simple plot in the first place. This does not mean that the plot must be commonplace and transparent; far from it, the plot may be an exceptionally clever one, though simple to picturize, since intricacy would add nothing to the novelty anyway. But the plot should call for simple action and simple camera-work. Once the plot is selected, it should be worked up in a simple scenario form which describes each scene, as will be shown presently.

Perhaps the best plots are those which have a touch of humor rather than pathos. A little love in

the picture makes it interesting, especially if young people are taking part in the photoplay. The old-time chase plot works out admirably for an amateur photoplay. The chase permits of plenty of action. much comedy, and yet there need be no difficult acting. The beginning of the chase plot may be any circumstance that suits one's fancy; thus it may be an elopement, with the irate parents following the young lovers in all manner of vehicles, yet with the young folks always a few laps ahead of them until the climax. The climax may come either at the parson's or in a less happy ending in the form of a spanking for the unsuccessful lovers.

In selecting a plot for the amateur photoplay, it may be well to avoid fast-moving comedy of the slapstick variety, for the reason that such photoplays are far more difficult to produce than they seem. It requires no end of special action to keep a comedy moving along; and when the best comedians in motion pictures find it hard work to make such comedies, it is obvious that this, indeed, is hardly a task for the layman to undertake.

At any rate, the producer should cast about and select a suitable plot, always bearing in mind that it is better to select a simple plot and film it successfully, than to select a wonderful plot with many thrills, yet score a perfect failure in the photoplay attempt.

Let us see how the scenario, in this case, should be prepared. First of all, a synopsis of the film should be sketched out in order to have it down in black and white, so to speak. Then we should make up a

dramatis personæ or cast, followed by a list of the different sets and locations, and in which scenes they appear. Finally, we should have the action of the story, arranged scene by scene for the direction of the players. Since there is no fixed standard for the scenario, any form will do just so long as it serves the purpose of the producer. The object of it all is to provide the director and players with a working plan.

Here is a typical amateur photoplay and its scenario:

"The Bit That Bit"

By Austin C. Lescarboura

SYNOPSIS

Percival Edison Swanson is the sissy of Swellington Manor. He doesn't play baseball, skate, fight, swear, climb trees, steal apples, and the other things the regular fellows do. But he is a wonderful swimmer, as fortune would have it.

The rival gangs are about to have a special fight on the pond. Each side is in a flat boat, stolen from the German hotel-keeper for the occasion. The boats are to meet out in the center of the lake, and the crew of each boat are to be equipped with long poles fitted with soft pads or buffers. The object of each crew is to bowl over the members of the opposing crew. Whichever side succeeds in disposing of its enemy wins the fight. It is the biggest event of the neighborhood, and whichever side wins is going to have things pretty much its own way with the girls.

Percival asks to join the gang from his immediate neighborhood. The leader turns him down. What good would he be anyway? Percival does some deep

Typical motion picture studio, with glass roof and sides, and a number of batteries of mercury vapor lamps suspended from trolley rails for top lighting. Lights mounted on wheeled stands serve for side lighting.

thinking and decides that after all he is going to take part in the fight.

The scene shifts to the fight. Percival's own side, which he would be with if permitted, is losing the fight. Two out of its eight members have been disposed of and are struggling in the water. While the fight is going on, a little float, carrying a glass tube extending several inches above the water, is seen to approach the enemy's flat boat. It comes alongside the boat. Presently a bit is seen to come up through the bottom of the enemy's boat. It is pulled back again, leaving a hole which admits water. The bit appears again in a new place, and again leaves a hole. Several times this performance is repeated, until the craft, filled with holes, slowly sinks. The enemy is decisively beaten as a result, and the triumphant crew row to shore. Once they land, they are confronted with smiling Percival Edison Swanson, with brace and bit and with a collection of rubber tubes, float and glass tube. So it was he who won the fight! And all the girls of the neighborhood hail the new hero who won by brains rather than brawn.

CAST

Percival Edison Swanson: Twelve-year-old boy with long hair, rim spectacles and all-round studious look. Must be good swimmer.

"Spike" Mulligan: Typical youthful roughneck, with more nerve than brains. Good swimmer. Athletic build.

"Skinny" Moran: Another typical youthful roughneck, with more nerve than brains. Good swimmer. Athletic build. Preferably much taller than preceding character.

Hans Schlossbergheimer: German hotel-keeper of 50 years of age, with cropped hair, beer-barrel front, and stern but fat face.

Village girls: As many girls as are available for the picture. All the girls should be between 12 and 16 years old.

Village boys: A dozen boys, all of them good swimmers and fairly athletic, to be employed in the water wrestling scenes.

SETS AND LOCATIONS

Typical village street:	Scenes 1, 7, 11, 18, 33.
Rowboat landing:	Scenes 2, 4, 6, 12, 14, 30.
Middle of lake:	Scenes 3, 5, 9, 13, 15, 17, 19, 20, 22.
Backyard and woodshed:	Scenes 8, 10, 24, 26.
Hotel porch, near lake:	Scenes 23, 25, 27, 28, 30.
Bank of lake:	Scenes 29, 32.

PROPERTIES

Two flat-bottom rowboats, one dozen long poles, preferably bamboo rods, fitted with buffers at one end. Small piece of wood for float, seltzer bottle, hatchet, brace and auger bit.

POSITIVE CONTINUITY SCENE BY SCENE

(*Title*) Boys will be boys, the world over. In the absence of a League of Nations and arbitration, the boys of Swellington Manor settled all disputes by force of arms—or fists.

Scene 1.—Fade-in on village street. Group of boys, headed by "Spike" Mulligan, coming down street. Percival Swanson walking in opposite direction, or towards them. They hail him. "Spike" informs him in a haughty, boastful manner that they are going to the lake for the big fight with rival gang.

(*Sub-Title*) "It's going to be some fight—and to the finish. We are going to show them stiffs that we ain't no dumbbells either."

Percival takes it all in, with awe. Registers a slow smile.

(*Sub-Title*) "Say, 'Spike,' can't you let me in on this fight. Of course, mother would never approve of

such an action on my part; but I should love to participate in the conflict."

"Spike" slaps his forehead with his open palm, as if to faint. The rest of the gang burst out with rude laughter and make all kinds of fun of the very much embarrassed Percival.

(*Sub-Title*) "Does your mother know you're out? Better run along, Percival dear, and not play with the rough boys. They ain't fit company for you, dear. Besides, this is going to be a real fight."

With a snap of his fingers, "Spike" starts off, followed by his gang, leaving Percival high and dry. He starts off in the opposite direction.

(*Title*) And all the while the enemy was busily engaged in putting its fleet in shape, with secret sailing orders—secret because Herr Schlossbergheimer was furnishing the men-of-war without knowing it.

Scene 2.—Scene at boat dock. "Skinny" Moran and his gang sneak up to boat dock and push one of the boats into the water. They climb in and push off from shore, rowing out of the picture. Then come "Spike" and his men, sneaking in like their predecessors. They select another of the several flat-boats and also push off and row out of the picture. Then comes Herr Schlossbergheimer, puffing from a short run, and, seeing the two rowboats gone, he scowls and shakes his fists at the boys in midstream.

Scene 3.—Scene in middle of lake. Rival gang leaders hail each other and rowboats manœuvre about for advantageous positions. They draw nearer and the boys begin using their poles, thrusting them at each other.

Scene 4.—Back to boat dock. Percival comes serenely along and is surprised to see the boats out in middle of lake. Expresses great excitement as fight progresses.

(*Sub-Title*) "My, oh my! There goes one of 'Spike's' men—and another, too. Oh, dear! that will never do. Oh, if I were only a boy!"

Scene 5.—Back to middle of lake. One boy from "Spike's" boat is struggling in water and another is just being pushed overboard by the rival crew. Things going badly for "Spike's" side.

Scene 6.—Back to boat dock. Percival, leaning forward with hands on knees, surveying fight intently. Shakes his head, sadly. Face brightens up. Slaps his hands together and prances about.

(*Sub-Title*) "Eureka! I have it! I'll show them if I can fight!"

He starts running towards the shore and disappears at high speed.

Scene 7.—Village street. Percival tearing up street. Group of girls coming in opposite direction. They hail him.

(*Sub-Title*) "What's your hurry, Percy?"

"Nothing! Merely giving my lower appendages a much needed exercise, you know."

Scene 8.—Backyard of country home. Percival rushes in, throws off hat and coat. Looks about frantically. Picks up a piece of wood and shakes his head with approval. Looks about some more. Spies a box of seltzer bottles on porch. Sneaks up and takes one. Plays the stream from the bottle on the cat dozing on window sill. Takes empty bottle to nearby stump and, with hatchet, breaks bottle without injuring inside tube. Takes tube and places it in a crack in piece of wood. Looks around and discovers some rubber tubing on door of shed. Takes this and fits it to end of glass tube.

(*Sub-Title*) "And now, my proud man, we shall see how brawn must give way to brains!"

Percival, smiling and enthusiastic, starts out of the yard and out of the picture. Fade-out.

Scene 9.—Middle of lake. "Spike's" boat has only "Spike" and two boys left. Rest struggling in water. "Skinny's" boat still has five, having lost one. "Spike" grabs a pair of oars and endeavors to flee, with enemy in close pursuit.

Scene 10.—Close-up of wet cat, licking itself and stretching out to dry in the warm sun.

Scene 11.—Village street. Percival comes tearing down street, with his paraphernalia trailing after him. Villagers look at him in amazement.

Scene 12.—Boat landing. Percival comes rushing up to boat landing. Begins to undress himself, while watching the fight in middle of lake. Displays great haste in his undressing operations. Gradual fade-out.

Scene 13.—Middle of lake. "Skinny's" boat catches up with "Spike's." Fight renewed. "Spike" can be seen crying. (Preferable to show a close-up of "Spike" and his crew in tears.)

Scene 14.—Back to boat landing. Nothing to show where Percival was before, except a pair of glasses hanging from the hand-railing. Close-up of glasses.

Scene 15.—Middle of lake, with fight on between boats. In foreground queer little float with glass tube is seen moving towards "Skinny's" boat. Then a head comes to the surface, but only back of it faces camera. Owner of head does not reveal identity. Float again starts off towards "Skinny's" boat.

Scene 16.—View looking down on "Skinny's" boat, showing fighters in boat and boat bottom. Bit appears through the floor, again and again, leaving holes, through which pours in the water. Water rises steadily and surely.

Scene 17.—Back to general view. "Skinny's" boat is seen to settle. "Spike" becomes courageous again, seeing his opponent's dilemma. "Skinny" becomes panic-stricken, and, being thrown off his guard, he is bowled overboard. One by one his men are disposed of as their boat disappears below the surface. "Spike" picks up the oars and with an air of triumph he starts back for the landing with his companions. Fade-out.

The balance of the scenario follows in the same general manner, the action being given scene by scene. Of course, the action may be more or less complete; indeed, the directors of even the professional pictures have plenty of latitude in what they cover for each scene. It is largely left to their discretion as to how much attention to give each phase of the story, and they use trick effects and close-ups as they see fit. The scenario is merely the skeleton outline, nothing more.

The titles, too, may be arranged very much to suit the fancy of the director. In some instances they are not included in the scenario, but it seems in amateur productions that for a better understanding of the action they are really necessary. Of course, these titles may be only the working titles, since it is always possible to improve on them after the picture has been completed. Titles play an important rôle in any picture, and too much care and thought cannot be exercised in making the titles as appropriate and entertaining as possible.

Director, cameraman, and assistant director making a close-up scene. The director directs the action, while the assistant director keeps track of the numerous details which are essential in maintaining a perfect continuity.

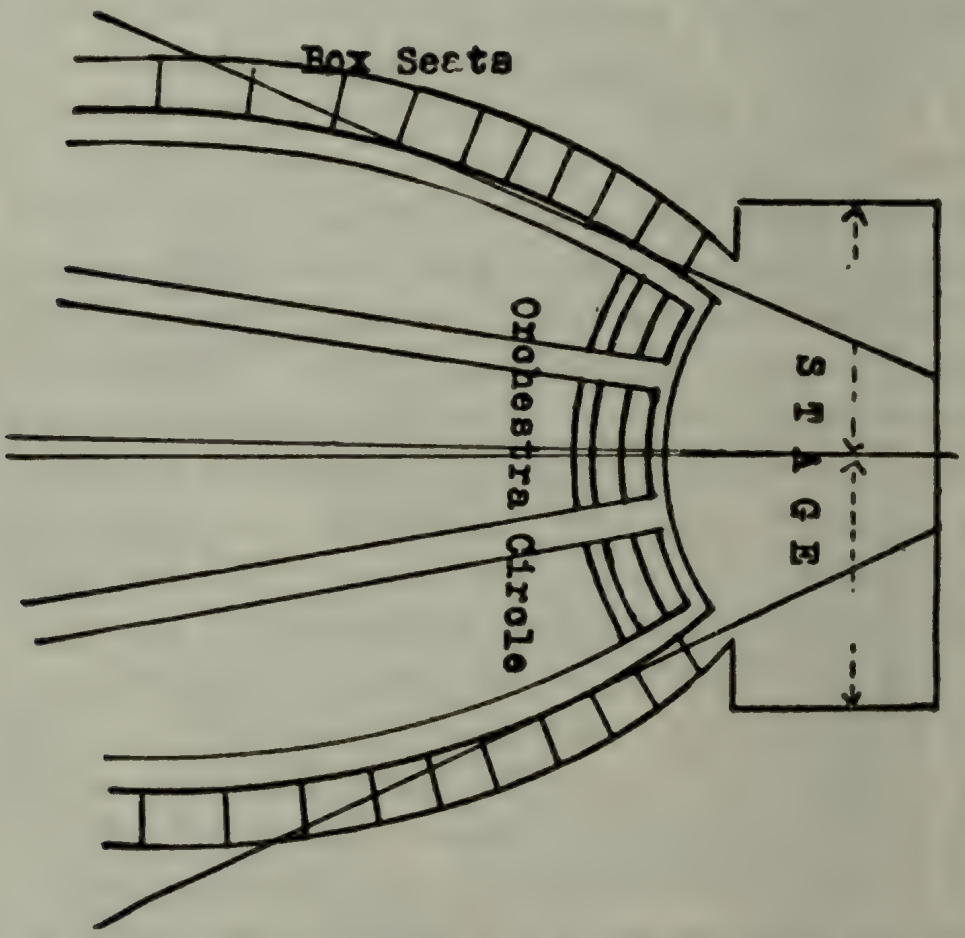
The Amateur Director

Something more than a checkered cap, a pair of puttees and a megaphone is necessary to qualify as a director of the amateur photoplay. Some experience in acting is an excellent foundation, to be sure; but it is by no means imperative. Many of our best directors in the motion picture industry have never acted and have had no connection whatsoever with the stage. Some of them have been trained as engineers, others as doctors, and still others as Army officers. A queer assortment, true; but that is precisely why it is hard to say just what makes a good director. It seems that the first essential is an inborn sense of leadership, for if anything motion picture directing is a matter of knowing what to have the actors do and then telling them how to do it.

In the producing of an amateur photoplay the director should not attempt to be a cameraman as well. When one tries to operate the camera and direct at the same time, something is almost certain to go wrong. The operation of the motion picture camera is such an intricate matter, especially if any special effects are to be obtained, that the operator must concentrate on the camera work to the exclusion of everything else. The directing of the picture, on the other hand, also calls for concentration; so it is quite obvious that each task must be kept separate for the best results.

If the production being attempted is at all elaborate, it is well to have an assistant director, whose duty it is to check up the work of the director. We

humans are far from infallible, and it is so easy to make serious mistakes. Thus one man can see the errors committed by another, even though the latter knows far more about the work in question. Hence



Schematic presentation of the theatrical stage and its relationship to the audience. Note that the field of actors narrows down the farther back the players go.

with two men on the directing end—the director and the assistant director—errors are much less likely to creep in, particularly glaring errors.

The Cast and Its Selection

In the matter of selecting the cast for the amateur photoplay, it must at once be evident that the task

is a more difficult one than in regular motion picture productions. In the latter instance the director has hundreds of experienced, professional players and types from which to select those best suited for the rôles to be filled, while in the amateur photoplay the more or less inexperienced players, whose numbers are limited, must be fitted somehow to their respective rôles. In fact, it is well to know just who are the players before selecting the plot, and then write the scenario around the players whenever this is possible.

Photoplay acting, at least speaking of the amateur variety, is not difficult. Indeed, it is simpler than the amateur theatrical, for the reason that the players are not required to memorize page after page of dialogue. In photoplay production the players are told what to do for each scene, rehearsed several times if necessary, and the scene is then "shot." Where the difficulty comes in is when highly emotional acting or otherwise difficult rôles are to be portrayed—but then there should be nothing of this kind in the amateur photoplay.

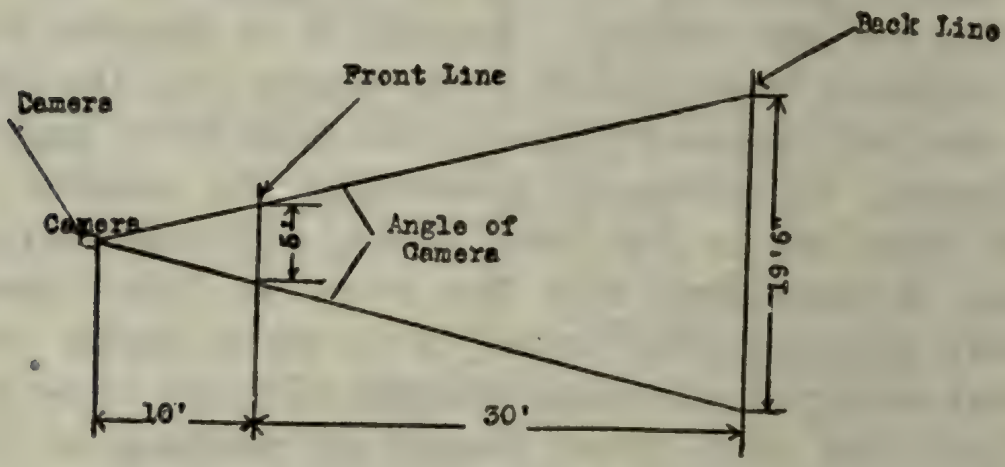
It goes without saying that the players should be picked out as nearly as possible for the rôle that suits their natural appearance and ways, since that eliminates the additional problem of difficult make-up.

However, there still remains a good deal to do in the way of make-up. Remember, we are going to do things photographically, and colors of all kinds are to be translated into simple black and white. Thus red photographs black, since the ordinary motion picture film is not sensitive to the reflected red rays. Hence as little rouge as possible should be used by

the players. An excess of white clothing should be avoided, because such clothing reflects too much light and results in serious halation on the film. It is best to use clothes which tend towards yellow, gray, blue and the darker colors and shades.

The Gentle Art of Make-Up

There are two reasons why the amateur players must make-up: first, to accentuate or tone down their features and to hide slight imperfections which



Schematic presentation of motion picture stage. Note that, unlike the legitimate stage, the field of action grows with the distance from the camera.

loom up big in the motion picture close-up; secondly, to even up all the players, so to say. In a given scene there may be a blond and a brunette. Without make-up, the blond will register faintly on the negative of the motion picture camera, while the brunette will register perfectly in a given length of exposure. Now in order to bring up the blond to a perfect exposure, it is necessary to prolong the exposure;

but the moment this is done the brunette becomes over-exposed and the screen result will then be a pasty white face, with little or no detail, for the brunette. So it is necessary by means of make-up to accentuate the face of the blond, and, in some instances, tone down the face of the brunette, in order that both may affect the film emulsion with equal intensity during the same exposure.

Make-up, as practiced by many of our leading motion picture players, is an art. Then again, with others it is nothing short of an atrocity—photographically speaking, of course. It is only too easy to overdo make-up, with unfortunate results on the screen.

The standard make-up consists in rubbing the face over with cold cream, followed by an application of Stein's No. 2 grease paint. In order to avoid the shiny or glossy effect, the face is then powdered with sufficient flesh or brunette powder. In the case of ordinary complexions, which are neither exceptionally light nor dark, and which have no prominent skin defects, such as pimples, wrinkles, moles, freckles, cuts, and so on, it is only necessary to use the cold cream followed by a slight application of suitable powder. In either event it is necessary to carry the make-up not only over the entire face, but down and around the neck and behind the ears, since the camera is almost certain to take a side view of the face in some scenes.

As for the eyes, the most important bit of make-up here is to shade the orbits very slightly with black or brown. Thin persons and persons with sunken

eyes do not require this make-up. The eyelashes, as a rule, do not have to be beaded, except for persons with blonde eyelashes or very sparse eyelashes, in which case black cosmetic is employed. A thin black line, made as close to the lashes as possible, serves to line the eyes of everyone except those possessing heavy black lashes.

Rouge is not a motion picture make-up; if anything, it is disastrous before the camera. If the player insists on rouging, it should be done on a very slight scale, since red photographs black on the screen. Lips should not be heavily rouged for the same reason.

Where wrinkles and other lining are required for the purposes of filling a certain part, they should be applied with dark red or brown and carefully worked into the rest of the make-up so as not to stand out like a sore thumb. The difficulty of elaborate make-up of this kind is that it is not an easy matter to deceive the camera, particularly in the close-ups. The same thing applies to wigs and mustaches and beards, which should be sparingly used. The mere fact that professional players are picked out as close to type as possible, and that these same players are required to grow a natural beard or mop of hair for a given production, even if such a procedure requires several months with pay, indicates how important it is to avoid artificial features when it is at all possible to do so.

Wigs, beards, mustaches and so on can be rented from a theatrical make-up concern or a costume rental agency when required, at a slight cost.

The Question of Rotation

With the cast selected and ready to face the camera, we are ready to go ahead with the "shooting" of the scenes. The director should decide on the order in which he will take his scenes, and as far as possible make all the scenes with the same background at one time. Thus by referring to the scenario list of sets and locations, on page 333, we find that the Typical Village Street setting is used for scenes 1, 7, 11, 18 and 33. If everything is in readiness to "shoot" those scenes, it is just as well to start operations here. Scene 1 is made first, or even scene 7 or 18 or 33, according to which arrangement is best. All the scenes called for with this background are made, after which the director moves his company to the next setting and proceeds to film the scenes called for with that background. It is this business of taking scenes out of order, so to speak, that calls for the exercising of no little care on the part of the director and the assistant director in order that there shall be no serious errors or omissions in the continuity of the scenes when arranged in their proper order. So if a player has a hat in one scene, it is absolutely necessary to remember that fact and see to it that the same player has the same hat in a related scene in the final film arrangement. Or if a young lady has a gingham dress in one scene in which she is leaving the house, she can hardly wear an evening gown in the next scene which, though taken two weeks later, shows her leaving the house supposedly the same day and at the same hour and

minute. Such errors are quite readily committed.

The director must use his head as to how to film his scenes. Good judgment will go far to expedite the work and thus consume a minimum of time and effort on the part of all concerned.

The Hand of the Artist

While the scenario outlines the skeleton action of the film story, the director can, of course, use unlimited license in filming each scene in order to secure the best possible film story. Thus he can call for close-ups and other little touches in each scene, resulting in a more complete and more understandable picture. Today the close-up is very much in vogue, and it is well to use it as much as possible. But in this and other matters pertaining to production the limiting factor is the footage at the disposal of the director. Most amateur photoplays run a thousand feet or less in length, and the director must endeavor to keep within the length specified. As an aid towards this end, he may jot down the tentative footage of each scene before he films it, and then try to keep within that limit. However he may decide to handle his footage question, the elaborateness of his picture is largely a matter of how much film he is to use for the final production.

It is really up to the director and the cameraman to frame the scenes as artistically as possible. Here is where the hand—or should we say the eye?—of the artist comes into play. A scene may be enhanced a thousand-fold by "shooting" it through a frame of trees or doorway or grape arbor. Instead of "shoot-

ing" scenes straight on, they may be filmed from an angle, thus adding to the interest of the picture. This, of course, is something which no book or instructions of any kind can ever teach; it must come from the individual cameraman or director, himself.

The amateur photoplay should be such as to avoid indoor sets, except where money is no object and the services of professional workers may be enlisted. Interior sets require a good deal of equipment except if the weather is warm, and these "interior" sets can be filmed on an outdoor stage. Little more than simple walls built of compo-board and properly wall-papered, together with the requisite furnishings, are required for a simple interior scene filmed outdoors. If the weather is more or less cloudy, the light is diffused and excellent for photographic purposes. But if the sun is shining, the set should be placed in the shade, or it should be covered over with suitable muslin strips to act as diffusers so that the direct light of the sun will not fall on the set and the players.

Indoor sets require artificial illumination, and then and there the players require powerful arc lamps or mercury vapor tubes for the purpose. The mercury vapor tubes are not as portable as the arcs, and for that reason the latter are more suitable. Two arcs of 25-ampere capacity each are sufficient to illuminate a very small set with two or possibly three persons taking part. For larger settings the amount of current required mounts up rapidly into hundreds and even thousands of amperes, making it prohibitively expensive. The author has obtained excellent results

with sets using actual home interiors, illuminated by two 25-ampere arc stands of the portable variety.

After all the scenes have been filmed, the negative is developed and a single print is made for purposes of examination. The print, which may be in one piece or a number of lengths, is projected on the screen so as to study the action and photographic qualities. Despite the fact that at the time of filming much of the action seemed vitally important, in the screen inspection it is usually discovered that much trimming can be effected with a decidedly improved presentation. So the director gets busy with the trusty scissors, and cuts here and there until the film is reduced to its essentials.

The titles must be prepared, and the working titles offer a good starting point. Many new titles suggest themselves and some of the working titles are susceptible to considerable improvement. But titles are of cardinal importance and too much care cannot be given to this phase of the amateur production.

Finally, when the titles are available, the positive print is assembled complete and projected on the screen for final approval. If it passes this final muster, as many prints as may be necessary are made after this pattern and the photoplay is finally ready for screen audiences.

Chapter X.

FILMING NEWS AND MAGAZINE FEATURES FOR THE SCREEN

WITH many of us, a motion picture camera is merely a means of entertainment, but with others it is a means of making money. A camera to the free-lance cameraman is very much the same as a typewriter to the free-lance writer: it is a potential source of money, but it cannot produce money unless the proper raw material, in the form of unadulterated brains, is supplied—and supplied plentifully.

The author is not pessimistic in this respect, but he merely wishes to tone down the over-optimistic spirit of many of those who rush into buying a motion picture camera and a few cans of film, and then expect to become a film magnate with little or no further effort. There is money to be made at free-lance motion picture work, yet it is anything but an easy game. The only thing that is easy about it is the cranking of foot after foot of negative film which proves to be absolutely worthless from a selling standpoint. Still, it is very much the same as free-lance writing for newspapers and magazines; because, for every article that is sold and appears in print, at least ten articles are never sold. Yet the capable writer, like the capable cameraman, sells article after article with little or no rejections, just because his ideas are good and he knows how to prepare them for the

editors. So with the free-lance cameraman; if he will study the requirements of his clients and then strive to please them, he can average a high percent-

News reel cameraman in action. There is no more difficult camera work than this kind. The men work fast and positively, and there are usually no "retakes."

age of acceptances and make a very attractive income from the sale of his film. At worst, it is no more difficult than writing as a profession or diversion.

The Inevitable Nose for News

The parallel between writing and film work is so closely drawn that we must dwell at length on the problems of the free-lance writer and how he solves them. Writing, after all is said and done, is a means to an end. Only too often is it considered as the end itself; that is to say, the beginner is apt to believe that if his essay is written in the choicest English and in a most brilliant style, he has a salable story. Far from it! The essay or article or story is a collection of words and sentences and paragraphs intended to convey a certain thought or bit of information. If it fails to convey the thought or information, it is nothing. If it does not contain an interesting thought or bit of information, or if said thought or information is old or too well known, the collection of words is useless from a selling standpoint.

In writing, the idea is the big thing—the very heart of the article or story. A worth while idea will cause the acceptance of an article or story that is poorly written.

Paralleling all this is the filming of short features for the news and magazine films now released by many of the leading film producers. These producers maintain large staffs of cameramen throughout the world, but as in the case of newspapers and magazines, they must depend to a large extent on the films submitted by free-lance cameramen. So important are the free-lance cameramen to these producers that they pay attractive rates for such films as they buy.

An explosion always makes an interesting news picture. In fact, the amateur aspiring to success in making news films should endeavor to obtain spectacular subjects. Always avoid the commonplace, for the news reels have only limited footage and only the best material can be used.

Indeed, this phase of motion pictures is no doubt the most profitable and simplest one for the enterprising cameraman seeking a means of earning money with his equipment.

But how about the ideas? That is just the point. No one is going to supply the cameraman with ideas except on rare occasions when, happening as he does to be located in some out-of-the-way corner, a film news reel editor may telegraph him to cover a given event. These assignments are generally few and far between, and the cameraman must dig up his own ideas. The digging process calls for a knack of knowing where to dig, and what constitutes a usable idea. This knack is known in the writing profession as a nose for news. It is usually a natural knack which is well-developed in some writers and cameramen, while with others it may be fostered by constant practice and experience.

The cameraman who aspires to contributing short features to the screen will do well to study the various magazines on the screen and news films, in order to gauge their requirements and general treatment. This is precisely what the successful contributor to magazines does in order to make sure of sales.

The next step is to obtain a list of news films and magazine films from a motion picture trade journal, and then drop a line to the editor of each, informing him of one's name and address, make of camera and the lenses available, territory that can be covered on special assignments, and where one may be reached by telegram. Most of the screen editors have some sort of form which they forward to the free-lance

cameraman and which he can fill out, so that they have his name and location properly filed away among their records, ready for instant reference.

What Is Screen News?

A study of the present-day screen news reels will reveal the fact that they attempt to be as broad as possible in their treatment of the current events. They do not parallel the newspapers so closely, mostly due to the fact that they are nation-wide in their circulation, as compared to the limited sphere covered by even the largest metropolitan newspaper.

So the usual screen news reel does not cover a murder case or a daring hold-up or startling burglary. It does, however, cover the important personalities of the day. Accidents are always covered by screen news reels, especially when they are of a spectacular nature. Important military events are good material, too. Strikes are acceptable, as well as other industrial subjects of importance. Sporting events of importance are very much sought by screen editors, especially horse races, airplane stunts, automobile races, motor boat races, and so on. Queer inventions and startling engineering undertakings are also acceptable.

Of course, the policy of the news reel varies from one editor to the next, and the free-lance cameraman will do well to see the various current news reels before making up his mind just what to submit to each one.

Perhaps the greatest error that is made in filming news for the screen is to overestimate the importance

of an event. In a small town, a given event, such as the fire department tournament, may be the greatest happening for miles around, and hundreds and even thousands of inhabitants from the countryside and neighboring villages may come to witness it. Yet to the news reel which circulates throughout the country, the fire department tournament of Armonk or whatever may be the name of the town, is of no interest whatsoever. Now if the tournament should by chance develop a startling feature, such as bowling over the squire's house by means of a stream directed from a hose, it may become so unique as to warrant space in one of the news films. But without spectacular features, it is purely a local event.

Unusual things, no matter where they happen, are acceptable material for the reason that the unusual is always news. Thus if the colored folk of a certain small town are to be baptized in the ice-covered water of a river, and the ice must be broken first so that the colored converts can go up to their necks in the water, that is a suitable news feature. Again, if the local smelter smokestack is to be felled by some exceptionally clever method, such as undermining its foundation and then supporting it with wooden beams, which are then set afire so that as they burn and collapse the smokestack topples over, that too is a news feature. If a villager is 125 years old, that is a good feature. Or if another villager makes his living in some exceptional manner, such as carving statues out of peanut shells, that makes good material for the news weeklies.

But in the final analysis the best way to determine

The launching of a ship always makes an interesting picture with plenty of action. In this case we have the launching of one of our latest submarines. Generally, however, two cameramen are necessary in order properly to cover such an event, so as to film the launching from two points simultaneously.

what is suitable material is to study the contemporaneous news films. Note how many subjects there are to the reel, and, by timing them with an ordinary watch, note how many feet of film are allowed to each. The average projector operates at 65 feet of film per minute.

Since motion picture negative is expensive, whenever there is sufficient time the cameraman who can ill afford to gamble on a possible acceptance will do well to communicate with the editor of a news reel, asking the editor if a given idea or event is worth "shooting." In this manner it is possible to determine what are the opportunities of selling the contemplated picture and if it is worth making. The editor may be advised by telegram in order to save time in urgent instances.

Covering the Story

The free-lance cameraman operating in any of the big cities will do well to secure a police card and fire card in order to go about his work unhampered and unmolested. In certain cities the authorities issue a combination police and fire card or pass which entitles the bearer or holder to pass fire and police lines for the purposes of making pictures. These cards are generally good for six months, although renewable.

Then again, the cameraman will do well to cultivate the acquaintance of one or more local newspapermen who can keep him informed as to what is taking place. In fact, it is even worth sharing part of the money received from the sale of films with the newspapermen in order to receive their tips from time

to time; because, let us not forget, the idea is the main thing in all film work.

The filming of an event should not be done in a haphazard, last-minute way. If the event is in the nature of a parade, tournament, sporting news, demonstration or anything else that cannot be controlled by the cameraman, and not as in the case of filming an invention or personality subject, the cameraman should be sure to go over the ground a day or two in advance and select and reserve the best positions from which the event may be filmed without obstruction.

When the event is about to take place, the cameraman should go over his camera, make sure he has the film properly threaded and the shutter and lens properly set. Events generally happen rapidly, and the cameraman must either film them without loss of time or ruin his chances of a salable film. In fact, it is generally admitted that news work is the most difficult and trying kind of camera work in the motion picture profession, for the reason that the cameraman has no control over his subject, he must work rapidly and under the most adverse conditions, and he cannot fall back on a retake when the results are not satisfactory.

There is no fixed rule for the handling of a news event, unless it be first to obtain a general view of the event, and then the details. Thus in the case of an automobile race, the cameraman might take a panorama of the race track with the cars speeding round and round, one or two close-ups of accidents, a shot at the finish, and then a close-up of the winner.

It is always well to start out with the general view and then feature the details; and when there is a man concerned, to wind up the job with a close-up of that man.

The main limitation on news features is their permissible length. Most features of this kind must not run over 50 feet of pictures, although the cameraman can send in one hundred feet or more and leave the job of cutting to the editor. It must be obvious that in order to have ten or more subjects on a 1,000-foot reel, the editor is obliged to cut down the pictures to 50 feet, since titles must be inserted, together with their appreciable footage. This matter of footage is a rather difficult one to circumvent at first, for the cameraman is apt to expend far too much film on his subjects by being too thorough. But after a while he learns what the "high spots" of any subject are, and finds little or no difficulty in telling the usual news story in 50 feet of action.

How News Differs from Magazine Features

It was during 1915 that the first so-called magazine film made its appearance. In order to cover certain short features which could not properly be grouped with the usual news features, one of the leading companies inaugurated a magazine reel which was released weekly. Today there are a number of screen magazines being released every week, which have for their object the featuring of all kinds of interesting things in science, travel, industry, fashion, discovery, and so on.

As far as the free-lance cameraman is concerned,

The news cameraman in war time has plenty of opportunities of seeing action. His outfit must be of the most compact and light construction, so as not to impede rapid movement.

the magazine reel is, if anything, a better market than the news reel, for the reason that time is not the very essence of the work. Whereas a news feature must be handled while it's hot, so to speak, the magazine feature may be made at almost any time within reason, so long as no one else gets around to it and films it first. Then again, the footage on the usual magazine reel is considerably greater than with the news film, so that the features may run as long as 250 feet in some instances. Some magazine reel editors believe in the short features, with five or six to each reel. In this case each feature runs about 125 to 150 feet, without titles. Other editors believe in longer features, say of 250 or 300 feet, exclusive of titles, with three subjects to the reel.

There is a definite line of cleavage between news and magazine subjects. The news must be timely and brief: the magazine material must be informative and rather detailed. Ideal magazine subjects are industrial subjects, such as how salt is obtained from the ocean, how tall trees are converted into masts, and so on. New methods of cooking are also acceptable as magazine subjects. Startling inventions can be covered in brief form for the news reels and in a more complete manner for the magazine reel. Travel subjects are used to a large extent in magazine films. Animal stuff of all kinds is excellent magazine material.

As in the case of news features, the cameraman would do well to study the present magazine reels and decide on their scope and treatment of material. One thing is certain, there is more opportunity of sending

suggestions to the editors of magazine reels and getting their approval before "shooting" the pictures. In this respect there is less gamble to the magazine features than the news, since there is plenty of time to submit a more or less detailed synopsis from which the editor can make up his mind. Indeed, editors like to receive the synopsis of a picture before the cameraman undertakes to shoot it, for the reason that they may want to make slight changes or improvements in the proposed handling of the subject.

Getting Away from Advertising Earmarks

One thing is fatal in all kinds of film work for the regular film companies, and that is advertising earmarks. There has been so much abuse of news and magazine reels in the way of accepting paid advertising films to parade as news or magazine material, that most exhibitors today are constantly on the lookout for anything that looks like screen advertising. The result is that most of the news and magazine editors will reject any film, no matter how good it may be, if it contains what appears to be publicity or advertising matter.

So in making subjects of either class the cameraman should keep an eye open for name plates, signs, and other earmarks of advertising. Often, in order to make sure of receiving permission for filming a given thing, the cameraman may make rash promises to the manufacturer or other party interested in the subject. There are too many parties always ready to exploit themselves on the screen or public print in

New machinery is always interesting news reel material. Here, for instance, is a snow-cleaning machine in action. The cameraman must take a number of views of such a machine to tell the story, some of these being close-ups that show the detailed operation, such as that on page 366.

return for information and facilities extended to cameramen and writers. When taking a picture that shows a name plate, sign, lettered part, or other sign of advertising, the cameraman should not hesitate to point his lens in such a manner as to avoid such things or, if necessary, efface them with black paint or white paint or by the use of some form of cover or screen.

This also leads to the subject of accepting money from parties who are anxious to have their products or ideas shown on the screen. While the cameraman may be justified in accepting money from such parties in return for the publicity, it is dangerous business in the long run. For somehow or other information of this kind always leaks out and soon becomes known throughout the business. And any cameraman who is known to be accepting money from persons or firms in order to have their products or ideas shown on the screen, is bound to find himself without friends in the business and without means of disposing of his films, even when they have absolutely no advertising value.

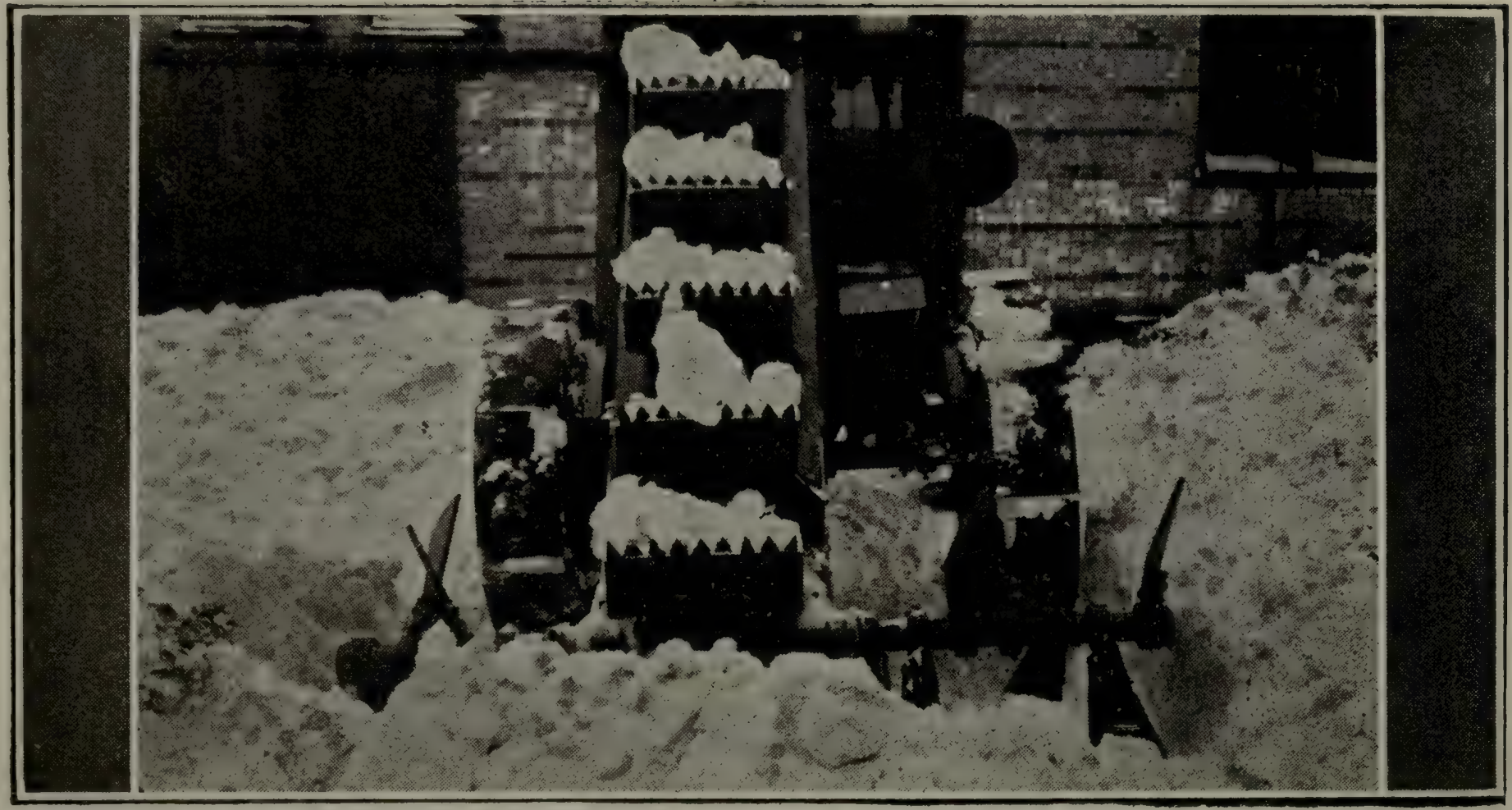
There is a definite place for advertising films; in truth, two chapters are devoted to them in another part of this work. But when it comes to news and magazine films, there is little room for advertising and publicity matter, no matter how cleverly it may be camouflaged. Perhaps some film companies themselves have been introducing paid advertising and publicity matter into their regular releases; but that is their business. They can afford to do it, since they are only accountable to themselves for their actions. But

they positively will have none of this practice from cameramen.

Getting the Film to Market

The news film should be rushed to the editor of the news reel selected without delay. It can be taken out of the camera magazine and carefully wrapped in black paper and placed in the tin can, which is sealed with adhesive tape. The news reel editors have ample facilities to rush the undeveloped negative through their laboratory and make a print, whereas several days would be lost by the cameraman. Furthermore, most editors prefer this practice for the reason that, outside of the time saved in the case of acceptable material, they are assured the first chance at the film.

The film may be sent by parcel post or express. The regulations in either event are quite complicated, but the local post office or express office will furnish full details and special labels which must be affixed on packages containing film. If the film is sent by parcel post, the cameraman should send a letter at the same time, informing the editor that the film is going forward to him under separate cover, and also enclosing a data sheet. The latter should give full details regarding what each scene is and what it covers, in order that the news reel editor can write his titles. Where there are personalities, the data sheet should give their names, thus: "Left to right, Mr. John Thayer Naylor, Hon. Mathew Egghorn, Mrs. John Thayer Naylor, and Rev. Alexander Beverley Hollingsworth."



Close-up of the business end of the snow-cleaning machine shown on page 363. It is highly important for a film to show how a thing works. General views are not sufficient. The news reel editor always wants to show how the machine performs its work by means of one or more close-ups.

In the case of magazine film the treatment is somewhat different. Instead of sending the undeveloped negative, it is best to have the negative developed and also obtain a print of it. The print is then submitted to the magazine reel editor, together with a data sheet. The editor can then examine the positive print and make up his mind as to its acceptance. If he decides to buy the subject, he so advises the cameraman, who then sends the negative.

If only the negative is submitted, the conscientious editor may refuse to pass upon the film in the absence of a print. If, however, he is impressed by the data sheet as to the importance of the subject, he may have a print made at the firm's expense for his own use. But as a general rule the conscientious editor will not pass on a negative and the cameraman is merely losing time. Then again, the absence of a positive print generally leads the editor to believe that the subject, in the cameraman's own opinion, is hardly worth the expense of a print. It is a confession of weakness.

There are a few editors—mighty few, let us be thankful for that—who may not hesitate to pass a negative through their projecting machines. Now negative film is delicate and should never be used in a projector, in which it may be subjected to strains and tears and even scratches. Such practice is unfortunate in the extreme, but it is certainly the cameraman's own fault for not submitting a positive print.

The rates for short features vary anywhere from 30 cents per foot to $1.00 for the regular run of good

material. For exceptional material the better news and magazine reels are paying $1.50 and $2.00 per foot. These rates, of course, apply to the film which is actually used, and not to the entire footage submitted. Some editors return the cuttings, or film which has been eliminated; others do not.

Aside from news and magazine reels, there is a market for short features running up to 500 feet in length. Certain companies are interested in split reels and do not hesitate to buy travel, scientific, educational, industrial and other subjects covered in 500 feet of film. But by far the best market is with the screen newspapers and magazines which are issued weekly and even semi-weekly, thus requiring a steady flow of material for the enlightenment of the peoples of the world.

Chapter XI.

THE WHY AND WHEREFORE OF SCREEN ADVERTISING

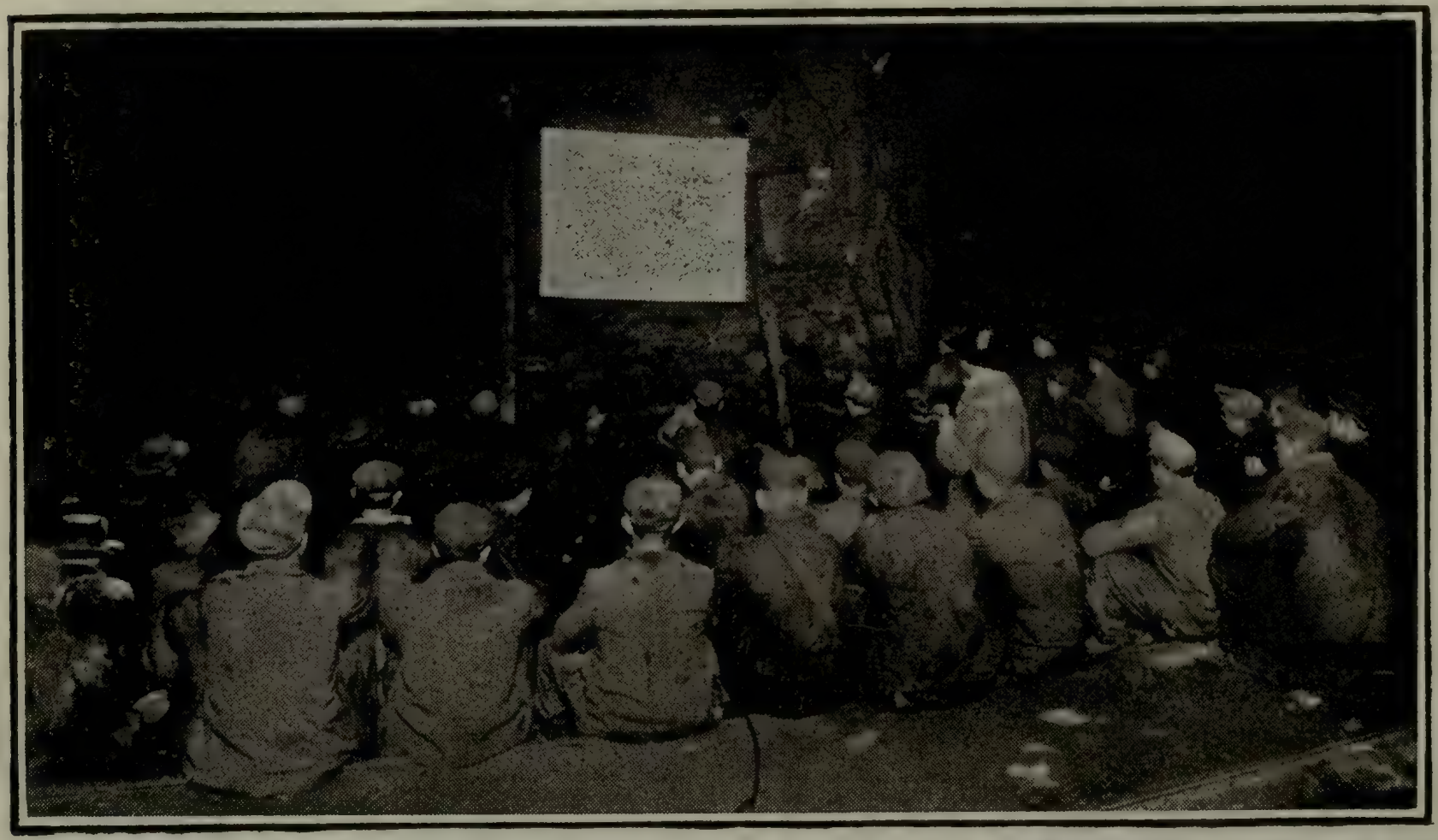
NO lesser man than Edison once made the remark that he could teach more science in twenty minutes by means of motion pictures than could be taught in a week with the usual text books. Edison was quite correct. But it has taken the world a mighty long time to put that wisdom to practical use; and even at this late date, when motion pictures have attained such phenomenal development in the fields of entertainment and news, our methods of screen advertising and selling leave much to be desired. In truth, this particular phase of the motion picture art—motion picture advertising—is still in its swaddling clothes, so to speak.

Where Motion Pictures Fit In

There is grave danger that motion-picture or screen advertising be misunderstood. The mere mention of motion pictures conjures all sorts of fantastic ideas. Screen advertising has come to be considered as an advertising cure-all by so many of the uninitiated. The millions of persons who attend the motion picture theatres of this country have been considered as so much circulation for advertising pictures. Yet after these matters are studied in the cold light of logic, the motion picture resolves itself into an excel-

lent form of advertising and selling, with tremendous possibilities if properly applied, but with many limitations nevertheless. Truly, motion picture publicity is not a substitute for all forms of publicity: it is a definite branch of publicity and merchandising, without which many a campaign is woefully incomplete. By itself, it may mean little; but in conjunction with the more conventional forms of publicity, such as magazine, newspaper, billboard, direct advertising, and so on, it is a powerful force. It is, in truth, the heretofore "missing link" in the highly intricate process of merchandising.

Having established the place of motion pictures in the scheme of business, let us consider what it can do. Motion pictures, first of all, are pictures, which means that they speak the only universal language extant. Secondly, motion pictures are animated, which means that they can describe any operation, process, feat, test or whatnot. Thirdly, the advent of the animated cartoon permits of showing any given bit of action step by step, so that anyone can become acquainted with it. Fourthly, the present-day technique of motion picture presentation enables a story to be told in detail, with pictures, animated cartoons and titles, and with such devices as the close-up, the cut-back and so on for accentuating certain points. Fifthly, the stage of any motion picture is the entire world. In the same reel can be incorporated scenes taken in China, South Africa, Canada, Texas, and Finland. And sixthly, let us not forget that motion pictures when presented on the screen have virtually one hundred per cent appeal or attention value. If there are



One of the most important uses for motion pictures is in organization work. Here, for instance, is an impromptu motion picture exhibition being given to a group of miners in the mine gallery. There is no better way to convey facts to workers than the motion picture screen.

five thousand persons in a large hall where a film is being projected, it is a pretty safe bet that almost every one of the five thousand persons will pay attention to the screen story from start to finish. In that way the screen producer is assured of an attentive audience and can go ahead on that basis.

A Study in Camouflage

It is the attention value of the motion picture story that has caused advertising films to be made and presented in theatres. There are some firms which specialize in screen advertising, undertaking not only the writing and producing of the screen advertising film, but also its distribution in hundreds and even thousands of theatres throughout the land. Such companies have arranged for the showing of advertising reels in certain theatres and can guarantee advertisers a certain number of bookings, just as a reputable periodical publisher sells a stated number of subscribers and newsstand readers to his advertisers.

At first blush this form of screen advertising appears highly effective—and it is in some instances. But one cannot deny the fact that there is a distinct note of unfairness in such a transaction, in that the theatre audience, which has paid admission for the explicit purpose of being entertained, is confronted with paid advertising on the screen. It generally follows that the greater part of the screen advertising must either be highly camouflaged so that the advertising angle is subtly and rather incompletely presented, or the film is a glaring piece of publicity and

only results in ridicule. In either event the advertiser fails to obtain what he paid for.

Now there are some advertising stories that are highly interesting. Thus there have been films made of the manufacture of American airplanes during the war. Such films, being released at the proper moment when airplanes were uppermost in the public mind, were gladly accepted as well worth while features for the usual theatrical program and consequently enjoyed a wide circulation. Then, too, there have been films of unusual industries which were of great educational value. There have been numerous scenic films which, while advertising some given route, have not smacked over strongly of publicity.

But when it comes to the advertising film that shows a given manufacturing process of a highly intricate character, with a crude attempt at sugar coating it with a little human interest or a touch of romance, there is grave doubt today whether such film is of real value to the advertiser who pays for its production and distribution.

One can never tell what will be the outcome of screen advertising: it seems to be such a chance game. For instance, in certain sections of the United States the theatre audiences have taken quite kindly to good advertising pictures of the industrial character, and as a consequence the theatres are even paying a moderate rental for such films. But this is exceptional; in most sections the theatres will only run the films for a consideration, and then all theatres are not open to such arrangements.

One of the great failings of many screen advertising

attempts is their long windedness. On the one hand the motion picture company is certainly not adverse to making as much film as the advertiser cares to pay for, and on the other the advertiser only too often believes that his screen story is the most interesting thing that has even been presented to an audience. So between the willingness to gain footage on the one hand, and the super-ego on the other, many lengthy films get to the theatre screen with unfortunate results. For example, there might be a certain film showing how rivets are made from start to finish; some two dozen views of a given piece of electrical machinery photographed from every conceivable angle; the story of tires from the gathering of the rubber to their use under every conceivable circumstance, and others. In each instance the story is too long, too complete, too detailed, for the usual theatre audience.

The Attention Value of "High Spots"

Screen advertisers should and must learn, sooner or later, what magazine editors have come to appreciate through bitter experience, namely, that this is a superficial age and the general public only wants the "high spots" of any given story. What cares the average theatre audience if the iron for rivets comes from Pittsburgh, is shipped in flat cars, must be refined and made into rods, then converted into rivets, packed in kegs, shipped to Borneo by tramp steamer, used in a dozen different ways, and so on? As far as the general public is concerned, perhaps the only thing of interest in that entire rivet story is the

machine that forms the rivets—that is *the* "high spot." Everything else simply becomes monotonous and militates against the value of the advertising appeal, if there be any such appeal in the presentation of such a highly specialized subject before a theatre audience.

The firm considering screen advertising should consider the popular interest in their product and story, just as the same firm consider the probable value to them of an advertisement in any of the general periodicals. For after all, who cares where rivets come from and how they are produced? Who cares whether spaghetti grows like wheat or if it is neatly cast in a pipe foundry? Whose concern is it if there are sixty-five distinct operations in producing an electric lamp or whatnot? Is it not the application of these products in which the general public is interested? Most assuredly, *yes*. If more screen advertisers were to bear that fact in mind, their efforts would be more effective.

Thus a silk manufacturer, instead of showing how the worms are cared for and how the cocoons are stripped of their silken coats, could show the champion embroiderer of the United States at work, scenes in some convent where wonderful pieces are made, and so on. The manufacturer of some prepared cereal could give animated recipes by leading dieticians and doctors. Such films would have a real educational value to the usual audience; and they would surely encourage the use of the products in question.

It is the application, rather than the manufacture, of any given product that is interesting to the general

public in ninety-nine cases out of every hundred.

But sooner or later the question comes up: Of what use are such films if the name of the advertiser cannot be conspicuously displayed in the films? And the answer is that under the usual system of showing such films in the regular run of theatres, all arguments to the contrary notwithstanding, it is impossible to do full justice to the advertiser's story, and still get the films before worthy audiences. This matter of paid advertising films in regular picture houses has been a matter of bitter controversy; there are many widely divergent opinions; and the outcome of it all must be awaited for the final verdict.

Screen Advertising That Is Good Advertising

Frankly, the paid advertising film in theatres has worked an injustice against screen advertising in general. It has created the wrong impression concerning the use of motion pictures in many quarters. As a matter of truth this form of screen advertising is only one of several—the simplest to sell to the usual advertiser, but the most difficult with which to realize results. It appeals to the imagination in the greatest measure. Its possibilities, on its face, are stupendous. For what advertiser can resist the temptation of placing his story before eight million persons or more!

The author, a keen student of motion picture publicity, believes that the near future shall see paid advertising films banished from practically all picture houses of standing. In place of this practice there will be the commercial theatre in every sizable town, where

paid advertising films will be shown to an audience which will be admitted free, but on special invitation. Hence the manufacturer of prepared breakfast foods will have his reel shown at the commercial theatre in a given town during a certain week; and prior to and during that time his local dealers will distribute invitations among their trade, asking them to go see the film in order to learn how the breakfast foods may be used to the greatest advantage.

The manufacturer of folding beds will have his reel shown during a given week in that same town; and prior to and during that week the local furniture dealer will hand out invitations to his trade, asking them to see the film which shows how New Yorkers are making a two-room apartment do the work of six rooms, thanks to the folding beds and other collapsible furniture of the manufacturer in question.

And the clothing manufacturer will show his reel, giving the latest styles worn by many notable persons; the talcum powder manufacturer and perfumer and others will show their reels on how to keep young and pretty and attractive, and so it will go without end. The various manufacturers will pay so much for the production of their films and their distribution. The latter will be quite costly, but no doubt well worth the cost in the long run.

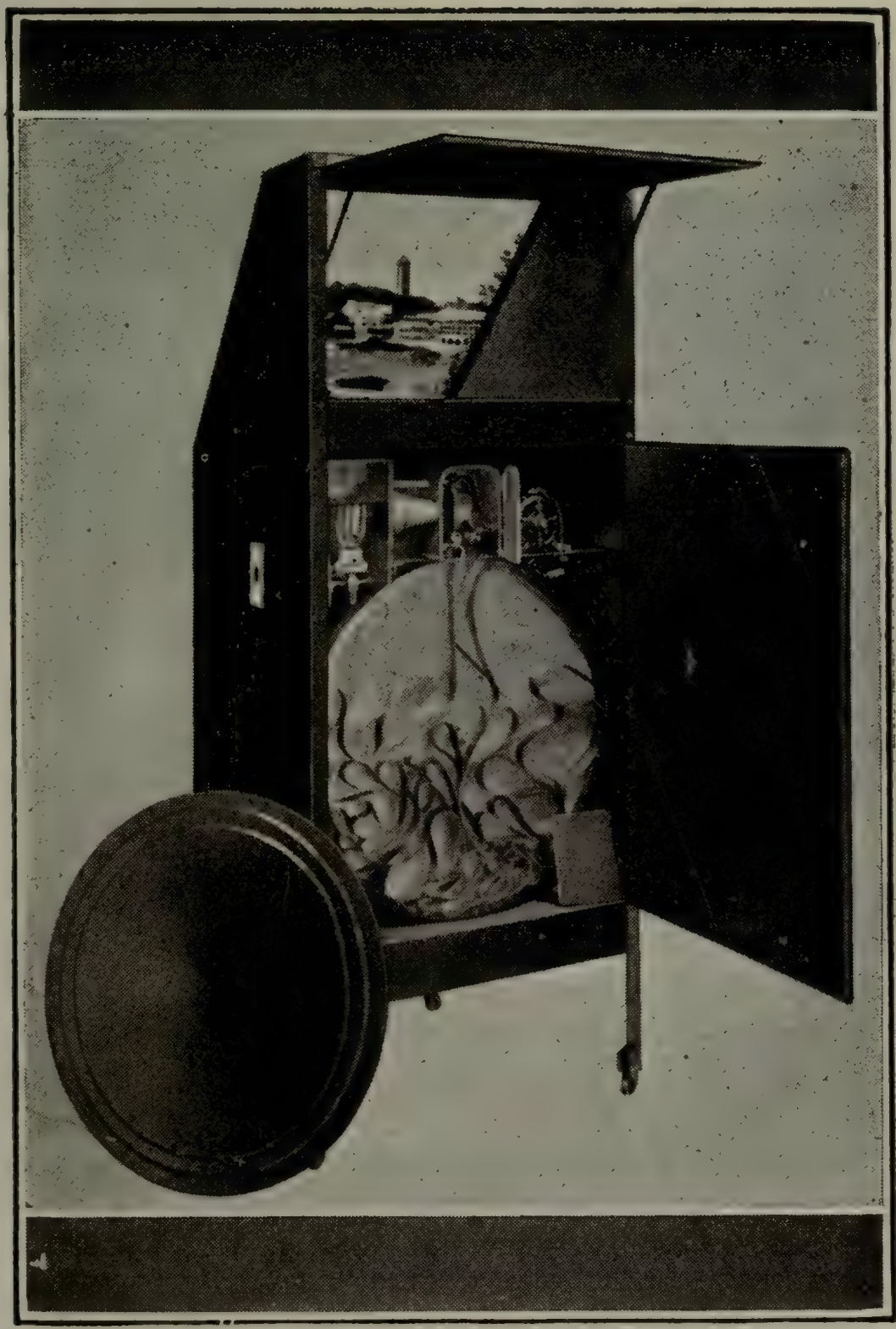
In smaller towns and villages, a commercial theatre will obviously be out of the question. In such instances arrangements will be made with the local theatres to run the advertising pictures early in the day, before the regular show starts. In this manner advertising reels will be shown everywhere. Such

films will carry the real advertising story, name, address, prices, terms and everything that the advertiser may desire, just like a piece of advertising copy in a magazine. There will be nothing to camouflage, sugar-coat, or soft soap. There will be no apologies asked for or granted; for this will be a direct appeal to an audience assembled in the theatre for that purpose. There will be no disappointments.

A Parallel with the Periodicals of Yesterday

The author cannot help comparing all this with the history of periodicals. It is well within the recollection of most of us when periodicals of standing ran paid write-ups or reading notices for advertisers, who believed in this form of sugar-coated publicity rather than the out-and-out, aboveboard publicity of the advertising pages. And we all know that the write-ups and reading notices passed away through compulsion, and that the advertising columns came to be the sole medium for advertising expression in all periodicals save the usual trade papers. Readers of general and class periodicals came to condemn those periodicals which ran write-ups and reading notices, and forced the publishers to abandon such practices or go out of business.

Now the motion picture advertising film need not be shown in the regular picture houses. There are many other places where it is certain to do more good. Thus the usual advertising firm may be shown at a convention, exposition, special show, before a body of interested persons, at a club meeting, engineering society, or even in the school or college room.



This handy little cabinet projector runs automatically and gives a motion picture exhibition anywhere and without attention of any kind. The pictures are shown in the shadow box. The film is in a continuous belt, and repeats over and over again.

There are organizations today which undertake to circulate advertising films among schools, before communities, in factories, and so on, and such distribution is apt to be quite profitable, if somewhat an indirect way.

Advertising films can be used to excellent advantage in any show window, booth, corridor or elsewhere by means of an automatic projector with shadow box. There are several machines of this kind now available, which solve the problem of projecting pictures where many persons pass by. Such machines are generally made of steel and the film, with its ends cemented together so as to form a continuous belt, is passed through the machine without attention of any kind. The shadow box makes it possible to see the pictures even in the most brilliantly illuminated spot; and when the pictures are to be projected on a wall or screen, an opening can be used at the rear so as to project the beam of light beyond the cabinet. An automatic switch arrangement shuts off the current in the event of a break in the film. In order to have no difficulty with insurance companies, municipal authorities and so on, it is well to use the Safety Standard or the Pathescope film in such machines.

Commercial films, which include advertising films, can be definitely divided into two classes, namely: general advertising or publicity films, and concentrated selling films. But both classes of films are more or less interchangeable. The general advertising or publicity film has more to do with broad selling ideas, such as interesting the public in the process of manufacture, the plant and organization behind the

product, the product in use, and so on. The selling film, on the other hand, gets right down to cold business: it shows why the product is necessary; why it is the best of its kind; and what it can do.

A Silent Yet Dynamic Salesman

There is a tremendous selling force in the well-handled film story. The talking points on any given product may be brought out to the best advantage in film form, and again we have the one hundred per cent. attention value. Often a salesman will have difficulty in securing a lengthy audience with a prospective buyer, hence it is impossible to present the necessary arguments one by one. Again, the prospect may be skeptical as to how the product or machine would serve his requirements. It may be that the product or machine is being used by a manufacturer or other party in a similar line of business or circumstance but a few miles away; yet one can hardly expect the prospect to spend several hours visiting perhaps a rival plant in order to see the results for himself. It is the salesman's job to sell the prospect; the burden of proof rests with him, not with the prospect.

The motion picture story changes all this. The salesman, equipped with one of the several excellent portable projectors now on the market, already described in this work, can invariably obtain the required time to show his pictures. Connection is made to the nearest electric light socket and the pictures are thrown on a white wall or small screen. The pictures may show the factory behind the product,

the manufacturing process, the product in actual use under adverse conditions, and so on—all general publicity matter; or it can come right down to selling talk. The film can contain animated testimonials in the form of products or machines in long and successful use; comparisons may be drawn between this machine or product and rival machines or products, as regards prices and quality. Animated cartoons can bring out the superior construction of a desired machine over others. In brief, the prospect sees the product or machine for himself, receives a highly concentrated yet lucid selling talk, sees how the product or machine is being used by others, and all without leaving his desk or losing valuable time.

Please note, all the while the prospect is giving his full attention to the screen. Compare this 100 per cent. attention value with the usual attempt of a salesman!

No longer is the selling film a problematical business force. Large machinery houses, store equipment companies, automobile companies, agricultural and tractor builders, and others are using portable projectors and films in their selling campaigns. Typical of the value of such methods was the case of a large millinery firm which, during the serious curtailment of railroad facilities some years ago, made use of many reels of films for showing the coming styles in hats worn by pretty models. In this manner the salesmen saved the time and trouble of taking along with them their usual dozen or more trunks. A number of reels of films and a light, simple projector served the same purpose. Only a few accessories in

the form of samples of felt, ribbons, trimmings, flowers, and so on, were required to complete the sale story. Obviously, the firms could not permit the buyers to decide on the quality of the materials used, hence the samples.

Bringing the Factory to Foreign Prospects

It is in the export field that the author looks for a surprising increase in the use of selling films and general publicity films. What is commonplace to us is of unusual interest to, say, the Chinaman, and vice versa. So little wonder, then, that we hear of the keen interest taken in American advertising films in distant lands. Indeed, such films can be shown in the regular theatres without the slightest hesitation, in marked contradistinction to their frequent unfavorable reception in these United States.

Then again, the selling films may be employed to excellent advantage by foreign representatives. What better assistance can the foreign representative have than a set of films showing the factory, manufacturing process, line of products, packing methods, shipping facilities, exceptional uses of the products, and so on? Such films are of incalculable value to the firm aspiring to a big trade with foreign lands. This is particularly true in those countries where a real confidence must be established with the prospective buyer before anything like trade can begin. The films may show the factory, organization and other features to the end of familiarizing the prospect with what the product stands for.

All of which comes down to the matter of cost.

Film is a quantity production proposition in this way: The negative is costly to produce, yet once produced, any number of prints may be made from it at a slight cost. Hence the more prints made the lower becomes the production cost per print. Considering the number of times a print may be shown to an interested audience and the large number of persons that can be accommodated at one time, the cost of film in reasonable quantities compares more than favorably with printed matter telling the same story and circulating among as many persons. But again, the author wishes to point out that film does not take the place of publicity and printed matter: it merely supplements them and rounds out the advertising and selling campaign.

Remember, film advertising and selling is not an advertising and selling cure-all. It is the "missing link" in many a merchandising campaign. It is practically indispensable in some form or other. But like all advertising and selling, it must be intelligently applied to produce the desired results.

Chapter XII.

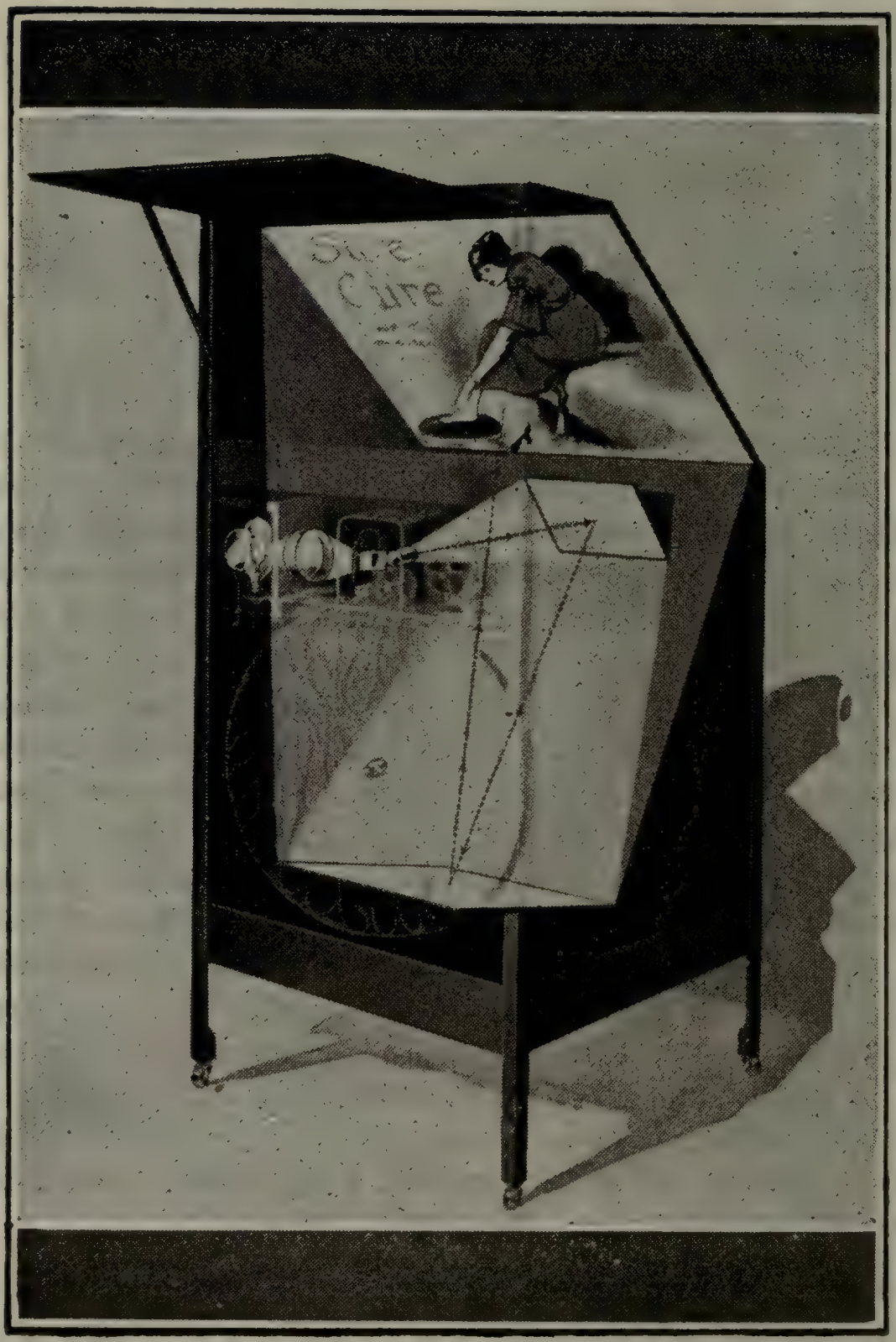
TELLING THE BUSINESS STORY IN THE FILM LANGUAGE

IN the previous chapter we dealt at length with the possibilities of motion pictures from an advertising and publicity standpoint. But it is one thing to discuss the possibilities of motion pictures and quite another to tell the business story in the film language.

It is usually out of the question for the average firm to make its own motion pictures, because of the heavy investment called for by a camera and other equipment. Furthermore, the making of motion pictures requires a deal of experience, and unless a considerable volume of such work is to be done, it will not prove satisfactory for the average firm to undertake its own filming. On the other hand, the large firm or organization that has a large amount of filming to be done can well afford to maintain its own motion picture cameraman and equipment, since by so doing the work can be turned out at a far lower cost than by calling in an outside party.

What Is the Job for the Film?

In considering the business motion picture, the first question to decide is, What is the purpose of the film? Broadly speaking, there are two main purposes for all motion picture films, namely, organization



Another view of the same projector shown on page 379. Note how the band of film passes through the mechanism, how the light is projected at right angles on to an inclined mirror, and from another mirror on to the inclined screen in the shadow box at the top.

work and merchandising work. The organization work includes films of safety first and welfare varieties, films showing better ways of doing certain tasks, and films of a general educational character, serving to inform the workers as to their daily work and its bearing on other activities. The merchandising films, on the other hand, are intended for outside showing, and serve to depict the size and activities of the organization to prospective customers, and to depict the advantages and applications and special features of the products being turned out by the organization.

The first essential of any film is that it be made interesting. A film that is not interesting will not appeal to anyone and therefore will be worthless. There has always been and always will be a tendency to rush into films just as there is to rush into print.

The organization planning to use motion pictures should analyze its business story most carefully, decide how much it is worth in film form, so as to know how many feet to confine it to, and then make a careful synopsis and working plan for the guidance of the film producer, whether it be an inside man or an outsider.

There is no more potent force in solving labor problems and industrial difficulties than film propaganda. For the motion picture enables the telling of a story in a direct, simple, yet most effective manner, whereas it would require thousands upon thousands of carefully thought out words to convey the same idea, and even then one might not be very successful when dealing with a low class of alien help with a very limited knowledge of the language. After all is

said and done, there is only one universal language and that is the motion picture.

Take, for instance, the doing of a certain bit of work in the shop. There is a right way and a wrong way, and as often as not the workmen will insist on doing it the wrong way just because they are obsessed with the idea that their way is better in the long run. Verbal arguments are often of little avail in such instances and it becomes necessary to use the motion picture method of discussing the matter. In this instance a motion picture can be made showing the wrong way first and then the right way, followed by a simultaneous showing of the right and wrong ways by splitting the picture and making a double exposure. Again, the difference in time required by the right and wrong ways may be brought out by including a large clock or even a stop-watch in the pictures. At any rate, such a film serves to convince the workmen that a given method is the correct one. The influence of wrong methods on the pay envelope can also be brought in, for with many workmen the pay envelope is the final criterion.

From Grinding Drills to Filing Letters

A leading twist drill manufacturing company has had films made showing the proper methods of grinding drills for use on different metals. It seems that much of the grinding has to be done in the tool-rooms of the manufacturers' customers, and no better way of giving instructions could be found than a series of films. Printed matter was tried, but it is one thing to get out good printed matter and quite an-

Filming an industrial picture in the steel works. Work of this kind calls for the employment of powerful portable arc lamps, so as to secure the necessary illumination. In fact, in planning an industrial picture it is well to make arrangements for the placing of the arc lamps some days prior to filming.

other to get customers to read it. But the films showed the proper way to grind drills for various uses and this method proved successful in getting everybody's attention.

Such films are, obviously, organization films on the one hand, and merchandising films on the other. There are many cases of this kind where a film can serve both categories.

Leading telephone companies have had films made to show the intricacies of a telephone call. Thus the employees of the telephone company are soon acquainted with the main details of the work in which they are engaged and get a broader idea of their relationship to the entire organization. Such an understanding is always bound to make for better service, since man was never intended as a mere bit of machinery. If man be permitted to think, he gives his best work, and not otherwise. A material saving in the time required to train an operator or repairman can be effected by the use of such films. Then again, the same films can also be employed for the general public, particularly at such times as the telephone service becomes somewhat less efficient, due to one cause or another. The films give the public a general idea of the many operations involved in routing a telephone call through two or more exchanges.

Thanks to the animated cartoon and animated model, it is possible to show the workings of elaborate mechanisms in a simple manner. Thus the intricate telephone mechanisms, automobile engine functions, loom operations and so on can be shown in a simple manner. A leading manufacturer of cash registers

has been using a film made up of animated cross-sections in order to provide technical instruction for repairmen. This is particularly true when a part is so small that to deal with it in its actuality would be difficult, especially when handling a fair number of students. But by means of the motion picture that part may be magnified to any desired proportion and shown to any number of students at one time.

The war served to prove the value of the film as an instructor. The war was largely one of machinery, with its ultimate ideal a flame projector or a rapid fire gun in almost every fighter's hand. Depth bombs, steam shovels, and machine guns had to be understood and operated almost in myriads, and in a great many instances by men who had nothing to do with such equipment before. All sorts of raw recruits had to be taught how to use these complex and costly mechanisms.

Animated sketches in films were made first of some of the simpler mechanisms and the results were so satisfactory to the officers detailed on them that plans were quickly made on a larger scale. Soon a student group in an officers' training camp was taken into a hall to be shown "moving X-rays" of the hand grenade, the operating interior of a machine gun, and cross-sections of cannon in the act of firing. And so it went.

Explosions were slowed down so that they were viewed as a progression of movements, seen through the open side of a gun. All the ordinary faults of operation were exposed, and their results, however dangerous, shown plainly and repeatedly without

harm. Once filmed, disaster and destruction were repeatedly reproduced in a hall without damage. Darkness except on the screen excluded all distraction. Subjects were displayed and removed from the canvas at will. There was no difficulty of crowding or craning. Everybody could see what was being exhibited.

By such means it took little time to turn raw recruits into expert operators of the most expensive and delicate machines of war. Before complicated instruments were touched they were perfectly understood in theory. From that point it was a short step to the proficiency that comes with manual familiarity. It was not merely illiteracy and the confusion of languages that were more or less brushed aside with the films, but deficiencies of vision as well. The least perceptive minds came before the screen on a level, in many respects, with the more imaginative.

Animating the "Help Wanted" Sign

There is almost no end to the uses of motion pictures in organization work. One leading company has found the film method invaluable for recruiting high grade help. A film has been made showing the activities of the organization, the ideal working conditions, the interesting range of products, and the advantages of working for such a concern. This film is circulated among colleges and engineering schools, thus serving to interest the young men to a more or less degree. What is the consequence? Many of these young men, who are seeking something to do as soon as they leave college or engineering school,

remember the film and apply for work at the company in question. Thus a truly high grade of help is secured at a minimum of trouble and expense.

So much for organization work. But how about the merchandising films—the films that are intended for the outsider?

Motion pictures can serve to bring the factory to the prospective buyer. In fact, that is one of the most important uses for motion pictures in business. Now any manufacturer can have a film made showing the extent of his factory and the processes involved in turning out his products. Such films have a wide appeal and at the same time have a very definite selling value. Thus the manufacturer of high grade clothing can have a film showing why his suits cost more than competitive clothing, laying great stress on the ideal working conditions, the consummate care used in building his clothes, the kind of men who wear them, and so on. The packer of canned goods can show scenes in his factory, depicting the extreme care exercised in handling the fruit, cooking it, packing it, and so on.

Films of this kind can be strictly technical, or a slight touch of human interest can be injected, depending on whether they are intended for the out-and-out hard-headed business man who has no time for any extra touches and frills, or for a more general audience. Films intended for theatrical showing must, of course, have a touch of human interest—a little story woven in somehow or other—to make it more attractive to the average layman.

Aside from the film introducing the factory and

its methods, there is the film that has to do with the products themselves. Thus in the case of machinery, it is well to show examples of the machinery being handled, with animated diagrams to bring out the essential features. The machinery can be shown in actual operation under adverse conditions. Such films follow the same general line of reasoning as would the usual descriptive matter in printed form, providing, of course, that they are intended for a prospective buyer and not for the theatre.

Putting It First on Paper—The Scenario for the Industrial Film

It is impossible in the space at the author's disposal to discuss how each business can be filmed to the best advantage, for each case has its own peculiarities and must be treated as something quite apart from anything else. Indeed, originality is very much to be desired, hence the less one knows about how others have filmed their stories the better the chances of success, providing, of course, that the essentials of a business film are understood and appreciated.

Once having decided on the type of film that is required, who is to be the audience, and how much is to be told, the next step is to reduce the idea to a synopsis on paper. The synopsis should then be submitted to various company officials for their suggestions and final approval, following which a regular scenario is prepared, quite similar to that for dramatic productions.

Here follows a synopsis and a typical working scenario or script of a publicity film:

SYNOPSIS OF THE MOTION PICTURE FILM ENTITLED

"PUTTING FLAX ON A MODERN BASIS"

BY AUSTIN C. LESCARBOURA

The story of flax culture is the story of 3,000 years of doing the same thing in the same old way. No one ever troubled himself to find new ways of doing the back-breaking work connected with pulling flax plants from the soil, or if anyone did, his efforts were unsuccessful.

Labor shortage of late has hampered all industries in a more or less serious way, proving especially harsh towards flax culture. Indeed, many of the flax fields have been abandoned or turned over to something else requiring less tedious labor.

With that background to begin with, this film story has to do with flax culture and its hardships under the former manual harvesting system. A workman is shown at work, breaking his back and wearing himself out, and finally accepting work with a farmer who has labor-saving machinery. The flax workers are shown to be growing less in number. Meanwhile the use of flax in the home and for other purposes is brought out, as well as the high prices asked for this material. Animated statistics are presented to show the demand for flax and the reduced output of late years.

Then comes the new XYZ Flax Harvester, which handles flax plants with the delicacy of the human hands yet does the work far faster and more efficiently than the former manual method. Conditions are changed by the introduction of this machine. Flax is again restored to its former importance and a promise for more linen and cheaper linen is made.

This story attempts to outline all these phases in a simple yet forceful manner. The arrangement of the scenario is based on the use of 1,000 feet of film, titles included.

LIST OF SCENES CALLED FOR IN SCENARIO

Scene in Typical Home: Bedroom, with bedstead, sheets, pillows prominently displayed. SCENES: 1, 27.

Scene in Typical Home: Dining room, with usual furniture but prominently displaying table with tablecloth, napkins and fine tableware, SCENE: 2.

Scene of Airplane: In flight and on the ground, the latter being a close-up of the wing surfaces. SCENES: 3, 4.

Scene of Flax Field: General view and close-up views with workers at work pulling flax. SCENES: 5, 7, 8, 9, 12, 18, 20, 29.

Copy of Old Wood-Cut: This wood-cut, showing the ancient way of cultivating flax, can be obtained in some old work on textiles. It may be borrowed from a library long enough to be copied on to the film. SCENE: 6.

Scene Along a Road: Any rural road will be satisfactory for this setting. SCENES: 10, 11.

Scene in Store: Corner of studio arranged to represent store, or this scene can be taken in a store if there is suitable light. Bargain counter with a few sheets and with extras for lending atmosphere and realism, will suffice. SCENES: 13, 14.

Scene in Textile Mill: Any interesting corner of a textile mill will do if modern equipment is being used. SCENES: 24, 25.

Another Scene of Flax Field: This may be somewhat different from the other flax field in order to break away from the same view. If so, then use it for SCENES: 21, 22, 23.

Animated Cartoon: Simple animated cartoons which can be made by anyone who can letter rapidly and easily. These scenes are not really animated cartoons in the sense of being taken one image at

a time. They are taken at the usual rate of speed, while the artist works at top speed. SCENES: 15, 16.

Outline Map of U. S.: Good outline map of U. S. without lettering but with the outlines of the various States plainly indicated. SCENE: 26.

TITLES AND CONTINUITY

(*Main Title*)

THE XYZ FLAX HARVESTER CORPORATION

presents

"PUTTING FLAX ON A MODERN BASIS"

A living account of how flax culture has been finally simplified and made possible on a gigantic and profitable scale after three thousand years of uneventful and even humdrum existence.

(*Following main title*)

Produced by

THE PHOTOFAX SERVICE

(*Sub-Title 1*).—Linen—The pride of the housewife.

Scene 1.—View in a typical home, showing a woman making the bed with fresh sheets and pillow cases.

Scene 2.—Another view in the house, this time in dining room, showing same woman setting the table with fresh tablecloth and napkins.

(*Sub-Title 2*).—Even to the wings of the airplane does linen find its way.

Scene 3.—View of a typical airplane, preferably flying sufficiently low to be clearly seen. Stunt flying if possible.

Scene 4.—Close-up of the same airplane, showing the taut linen wings. The aviator presses the wing surface with his finger to show strength of stretched linen surface.

(*Sub-Title 3*).—Where linen comes from.

Scene 5.—Fade-in or circle in on a field of flax, and then panoram to show as much of the expanse as seems desirable, to give idea of magnitude.

(*Sub-Title 4*).—Flax, from the fibre of which comes our linen, has been cultivated for the past 3,000 years. Throughout that period, and up till the present, the slow, laborious hand-labor system of harvesting has been in vogue.

Scene 6.—Copy of an old wood-cut, showing the cultivation of flax as far back as possible and which indicates the date or era, if possible. This cut must show hand-labor operations of some sort, preferably pulling the flax plants. Fade-in on such a cut, and, after five feet or more, fade-out.

(*Sub-Title 5*).—Today, in the age of the harvester, telephone, radio telegraph, printing press, railroad, automobile and airplane!

Scene 7.—Fade-in on flax-field, showing several workers pulling the flax plants. If possible, have the workers in this scene correspond in position and work to those shown in cut comprising Scene 6.

Scene 8.—Close-up of worker pulling flax plants. After pulling several times, the worker stops and closes his eyes to register fatigue. He stretches his arms and curves his back, registering aches from constant bending and pulling. Returns to his work, with a shake of the head to register that this, after all, is the inevitable way of obtaining flax for the world's linens. Circle out.

(*Sub-Title 6*).—The end of the hard, long day.

Scene 9.—General view of flax field and workers, taken with sunset effect. Workers lay down tools and put on their hats and coats, departing one by one from the field.

Scene 10.—Same worker as in Scene 8, walking along country road. Meets farmer, coming in opposite direction, who stops him to engage in conversa-

tion. Worker registers great interest in what farmer tells him. Farmer bangs fist on open palm to indicate the weight of his arguments.

(*Sub-Title 7*).—"Why do you work with your hands and back? This is the twentieth century, my boy! The age of machinery! Why, you are a fool to stick to that nerve-racking work. Come and work on my farm—work with a gasoline tractor, seeder, cultivator, and so on!"

Scene 11.—Flash back to Scene 10. Farmer still talking emphatically. Reluctantly, with a nod of his head, the laborer accepts the offer. Farmer pats him on back and nods head to register that he is making a wise change. Gradual fade-out.

(*Sub-Title 8*).—It is the nature of the work that has turned workers away from the flax fields, especially of late years. Our requirements now would call for 400,000 acres devoted to flax culture to be independent of European flax raisers. But how can we cultivate without cultivators?

Scene 12.—Same scene as Scene 9, showing half as many workers and taken during the day, instead of at sunset. Workers still bending over and pulling flax plants. Fade-out.

(*Sub-Title 9*).—And the inevitable result.

Scene 13.—Same woman as in Scenes 1 and 2, in store, buying linen sheets. The sheets are on display, with large cards reading, "Bargains—Linen Sheets, only $3.00." Woman picks up one of the sheets, examines it, and registers disgust. Clerk comes up to wait on her, registering a smile. Woman, with indignant glare, faces the clerk.

(*Sub-Title 10*).—"Do you call this linen? It is nothing more than cotton. You would have to use a microscope to find the linen threads. Why, this is an outrage. I used to buy real linen sheets for much less than you ask for these cheap imitations. What is the world coming to!"

Scene 14.—Cut back to Scene 13, same characters in same position. Woman is shaking her head as she talks and expresses her opinion. Registering contempt, she throws sheet back on counter and walks away. Clerk shrugs her shoulders and folds up sheet. Fade-out.

(*Sub-Title 11*).—**More flax and still more flax, is the cry of today. But flax becomes increasingly scarcer as the workers turn to other fields in which labor-saving devices are in use. Here are a few statistics indicating the true flax situation:**

Scene 15.—*Animated Cartoon:* Lettering appears at the point of pen of artist, as follows: "To meet the present requirements of about 10,000 tons of raw flax a year, the United States would need about 50,000 acres devoted to flax raising."

Now draw square and mark it 50,000 acres. Lettering continues as follows:

"To raise the flax needed for our present raw material requirements and to manufacture our own linen fabrics, we would need 400,000 acres."

Now draw square eight times as big as first square, and label it 400,000 acres. This lettering may be down on a long sheet of paper or cardboard, which can be shifted along as the lettering progresses.

And so it goes, scene after scene, with all the titles indicated on the working script. But it should be remembered that there are almost as many ways of preparing a scenario as there are persons doing this kind of work. There is no fixed rule. The author, who has done considerable scenario writing for industrial purposes, as well as produced industrial films, is in favor of the foregoing form because it is quite complete as it stands. By making several copies of such a script, it is possible to follow the work

right through without a hitch. The same script is given to the title maker for titles, and to the editor or assembler of the film for the proper arrangement of the scenes and titles.

For those who are engaged in producing industrial films for companies large and small, it is well to produce some sort of a script for the client before starting actual work. It is a fact—and there is no use attempting to get away from it—that the client always feels that he knows more about his product and sales story than any one else. Why not appeal to this ego? And then it is safer; for once the client approves of the script there is that much less chance of his complaining about the finished film story. Most of the producers of commercial films go to great pains in preparing their scripts for clients. These scripts follow more or less the general lines of the foregoing sample, being neatly typed in black and red inks and having the sheets bound in heavy paper folders. Generally, the script includes a schedule, showing on what days the cameraman and directors will take certain scenes, in order that the client can arrange to have certain departments ready on those days and in this manner disturb the plant's usual routine as little as possible. Such a schedule, too, is of great help to the electricians, who must wire up the lamps when the films have to be made in dark corners of a plant.

Wherein Motion Pictures Differ from "Stills"

It is difficult to say much regarding the making of an industrial subject, since each case stands by itself.

But one rule that may be applied to all subjects is to make them as interesting as possible, not only by selecting those phases which are replete with information of the worth-while kind, but full of action, as well. A motion picture must have action in order to make it interesting; otherwise, one might as well make a "still." So as far as possible the producer of an industrial film should seek to get plenty of animation in all his scenes.

Another feature which should not be overlooked in making the advertising picture is to use plenty of detail scenes; that is to say, close-ups that show the details of any given bit of manufacturing or the operation of equipment of all kinds. The trouble with many existing advertising pictures is that they deal solely in broad generalities, and overlook the important details. Thus if a view of a machine shop is included in the film, it is well to have close-ups showing the operation of an automatic lathe, planer, gear cutter and so on. Or if a gasoline engine is shown, it may be well to show some of its details, such as the governor, ignition equipment, and so on. As far as possible, the producer of the picture should place himself in the position of the audience; remember, the audience knows very little about the subject, and everything must be made perfectly clear without making the picture monotonous. Naturally, if the picture is intended for a popular audience, then the details do not have to be so complete; but if the picture is intended for an interested audience—for business purposes, so to speak—then the film should contain all the necessary close-ups, just as a trade

paper article differs from a story on the same subject in the daily newspaper.

Too much attention cannot be paid to the how-it-works side of filming, especially when dealing with mechanical subjects. This is an age of mechanical curiosity; by that the author means that the people of today want to know how a thing functions, whenever possible. The automobile, electric bell, telephone, electric light, electric motor and other present-day devices have made mechanics and electricians out of most men and women; hence we can film subjects with simple diagrams without fear of making our film presentations too formidable. To this end it is well to employ models that are broken away or cut in half in order to show how the parts function. Better still, it is well to employ simple wooden or cardboard models, as described elsewhere, in order to emphasize certain features. The animated cartoon, too, can be resorted to with excellent results. Since this work is quite technical and requires special training, the producer would do well to outline what he wishes to cover with animated cartoons, and then turn the job over to a concern specializing in cartoon work.

The editing of the finished advertising film calls for a good deal of skill and judgment. As in all filming activities, it will be found upon reviewing the many bits of film that some of the action that was considered indispensable and remarkable at the time of filming proves quite useless and monotonous on the screen. Of course, it is difficult to discard film, just as it is difficult to discard type matter that

One phase in the preparation of the industrial film—editing. The positive prints of the various scenes are projected with some portable projector as shown here, and carefully studied for superfluous action, poor photography, objectionable features, and so on. The film is then cut and assembled accordingly.

has been set up and paid for. Still, there is nothing that tends to ruin a story, whether it be in film or type form, more than to carry a lot of useless detail which impedes rather than aids the story. Editing should be done as thoroughly as possible, and without regard to how much film must be thrown out in the final cutting. Better to have a shorter film with the story well told than a long film which repeats and draws out and tires the audience. Padding is always fatal to success.

Captions should be prepared with a great deal of care. In every instance the wording should be considered from the standpoint of conciseness and clearness. Remember, a screen caption cannot be as long as a printed article: the information must be told in the smallest possible number of words. Furthermore, titles should be sparingly used, for there is nothing that tends to make a film story more uninteresting than too many titles.

Once the film is ready for use, the advertiser should decide on his projecting equipment, if he has no such equipment to begin with. If the film is intended for non-theatrical use, it is well to have it printed on non-inflammable, "safety standard" film, and to employ one of the several makes of projectors intended for such film. If the film is to be employed both for theatrical and non-theatrical purposes, the prints may be made on standard film and used in conjunction with standard theatrical projectors and with one of the many portable and semi-portable projectors described elsewhere in this work. Standard professional sized film with slow-burning base is excellent.

There are many opportunities by way of obtaining distribution for advertising and industrial pictures. In fact, there are various organizations which undertake to distribute such reels in schools and colleges at a very moderate fee, and in many instances such distribution is bound to prove profitable, especially at this time when the advertising fraternity believes in "selling" the young folk because they are more receptive and ideas embedded in their minds persist till later life.

Then it is also well to distribute advertising and industrial films among the immediate trade. Dealers should be told that reels are available for their use whenever they desire to show them. The reels are only loaned, of course. At any rate, advertising and industrial reels do little good in vaults, and it is imperative to keep them in circulation in order to realize full value from them.

Chapter XIII.

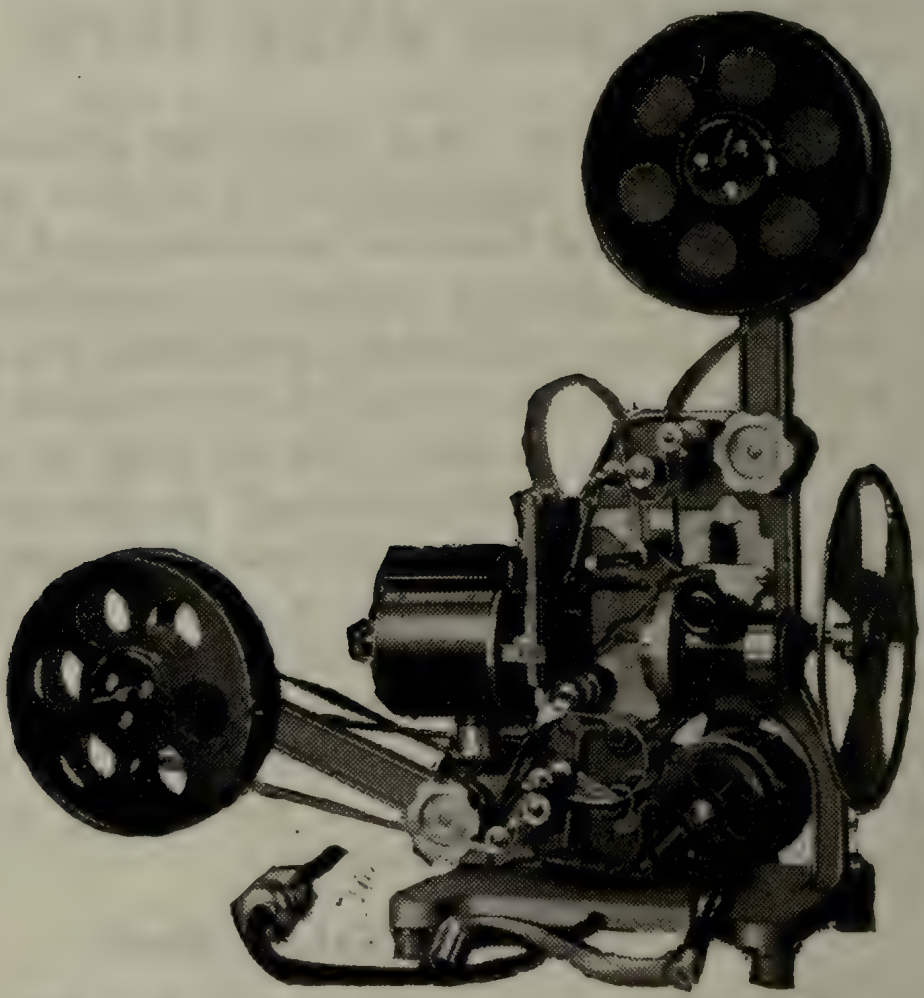
THE ACETATE FILM, OR MOTION PICTURES MADE SAFE

BEYOND the shadow of a doubt, the greatest step forward in the development of motion pictures during late years has been the introduction of the acetate of cellulose film—a virtually non-inflammable base carrying the photographic emulsion, yet possessing practically all the physical and optical advantages of celluloid. Indeed, just so long as motion pictures were limited to celluloid, motion pictures were more or less limited to theatrical usage; for it is obviously not good practice to project and to handle such highly inflammable films anywhere but in the projection room of the theatre, where a skilled operator is in charge of the projector and has at hand every possible means of preventing or combatting a fire at its very inception.

A Question of Safety First

The first commercial non-inflammable film came out of France—out of the big laboratories of the firm of Pathé Frères. With characteristic imagination the French film men realized that in the development of a safe film they had the means of expanding the field of motion pictures to an unlimited degree. Safe film immediately made it possible to introduce motion pictures in the home,

church, club and school; and the portable projector became a reality, not in some makeshift form but in a properly designed, simplified, safe form. The idea soon took shape in a practical projector of

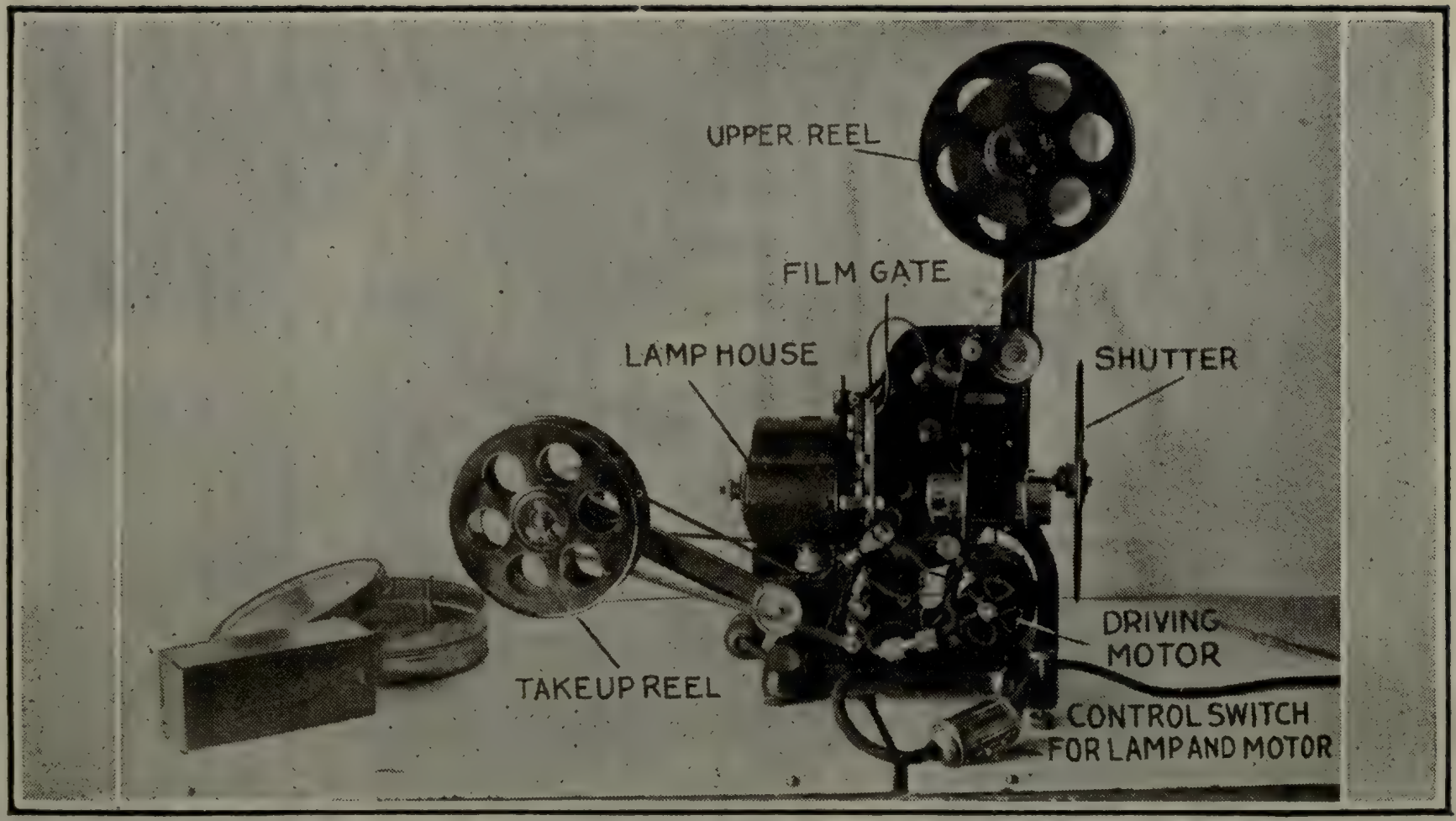


The New Premier Pathescope Projector set up, ready for operation. This machine makes use of safety film, and is available for use everywhere and by anyone.

utmost simplicity, known as the KOK projector, and in numerous reels of safety film that were copied from standard reels. In order to differentiate between the theatrical film and the new safety film, the

latter was made of a smaller size and provided with a characteristic perforation which is shown in the drawing on page 28. This special size as well as the special perforation prevents standard celluloid film from being employed in a safety projector under any circumstances, while rigid patents covering the perforation serve to prevent unscrupulous parties from making celluloid film of that perforation to fit the safety projectors. Hence safety is assured under all circumstances.

Some years ago the non-inflammable KOK film was brought to the United States and introduced under the name of Pathescope. An extensive collection of non-inflammable films was brought from France and to this were added numerous reels of American subjects, thus laying a foundation for the Pathescope Library. Films have been added regularly and systematically until today there is practically no end to one's choice of subjects, whether one's interest runs in the direction of science, travel, natural history, classics, drama, or just plain and wholesome comedy. Indeed, the Mary Pickford, Douglas Fairbanks, Charlie Chaplin, Norma Talmadge, and other films are printed on Pathescope stock but a short time after they have appeared in the theatres. Hence the Pathescope patron may bring his favorite star to his home screen whenever he chooses. The reels may be rented by the day or week; again, the Pathescope patron may be an annual subscriber to the Pathescope Library with the privilege of exchanging his current five reels or more every week for as many new reels.

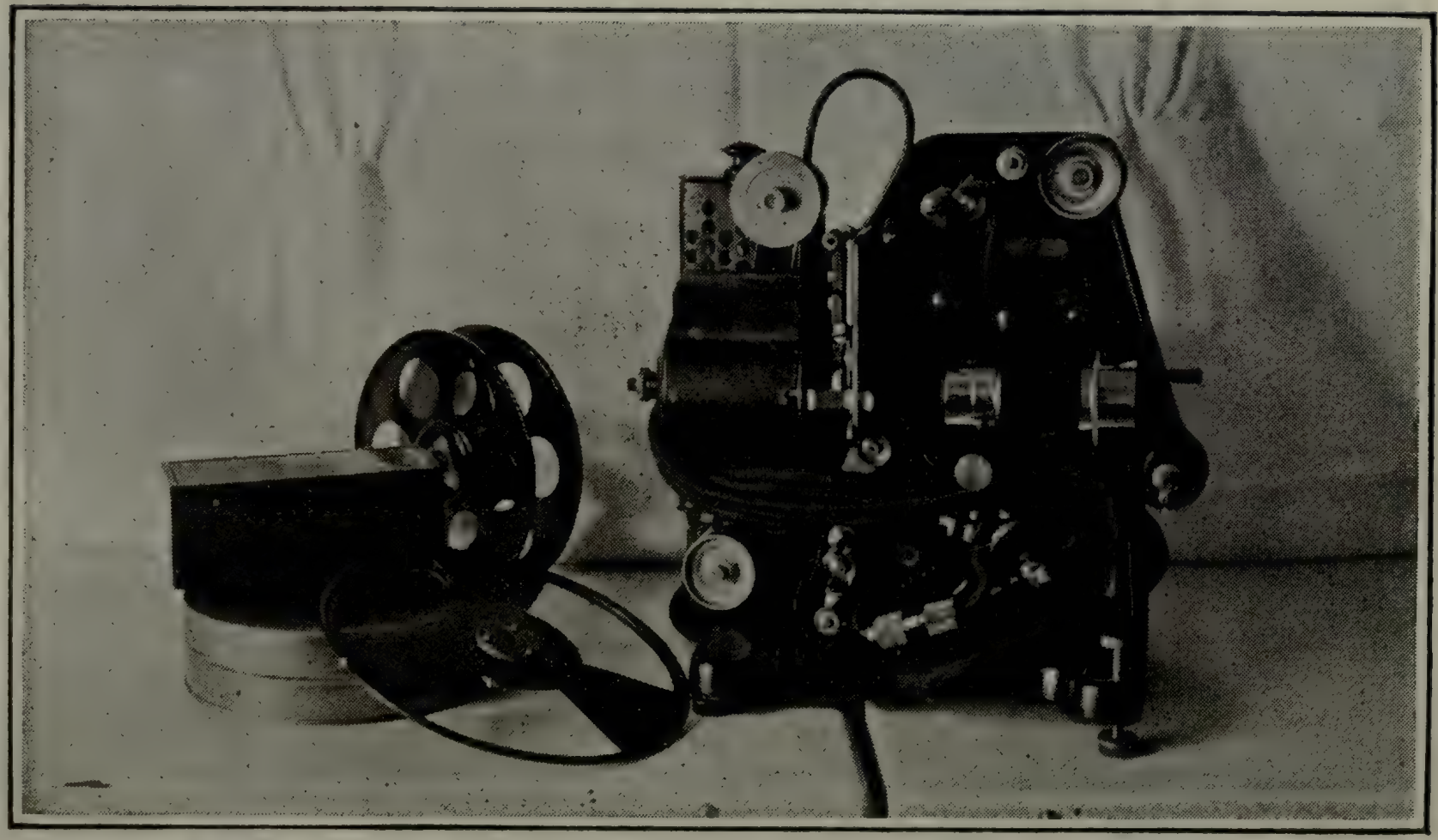


The New Premier Pathescope Projector employed by the author, with the various parts indicated. The little box at the left contains extra lamps, a screwdriver, tube of special graphite, bone scraper for the film gate, stiff bristle brush for brushing sprockets, chamois for cleaning lenses, and so on.

Americanizing a French Projector for Various Uses

For many years the French KOK projector was employed by the American Pathescope organization, but with the advent of the war and the difficulty of obtaining KOK projectors from France it was decided to design an American projector for handling Pathescope films. This projector, known as the New Premier Pathescope, has been on the market for several years and has proved to be more practical in many respects than its French counterpart, being more in keeping with American ideas and practices. No end of credit is due to Mr. Willard B. Cook for bringing the KOK projector and Pathescope film to this county; for designing the New Premier Pathescope projector, and establishing the Pathescope library and non-inflammable film service on a sound and practical basis.

As long as the non-inflammable film remained the exclusive property of one firm, because of the patents protecting the size and the perforation, it is quite obvious that the new film could not be taken up by other interests and developed to the fullest extent. But in April, 1918, the matter of a standard non-inflammable film was brought up before the Society of Motion Picture Engineers by Mr. Alexander F. Victor, with a view to putting an end to the indiscriminate use of portable projectors which, in some instances, has been a menace to public safety and the good repute of the industry. It appears that this suggestion, namely, to adopt a new Safety



The author's Pathescope projector dismantled and folded up for storing it away or for carrying it about. A special carrying case, shown on page 414, may be used for portable purposes.

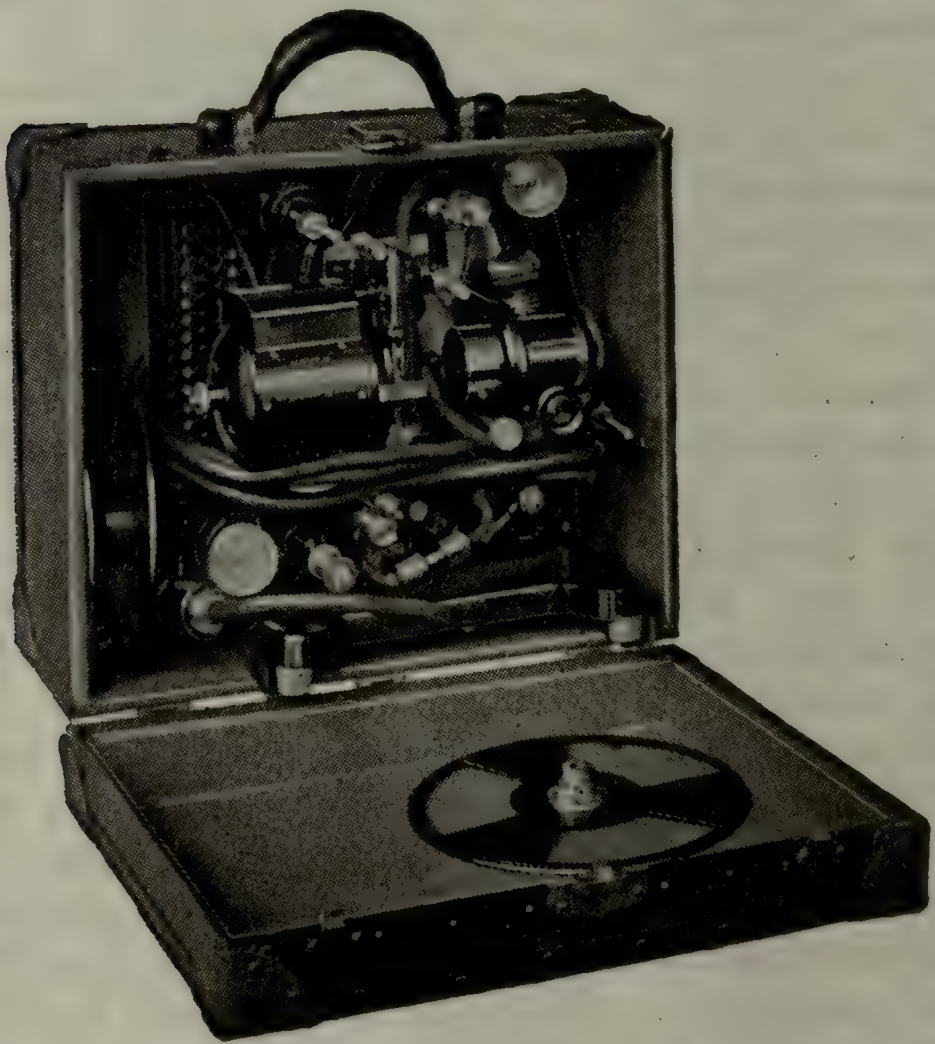
Standard film for non-theatrical use, met with a great deal of opposition, particularly from certain manufacturers of portable projectors.

When an industry such as the motion picture industry had reached what amounted to 100 per cent. standardization, with a film that would fit in any machine, whether theatrical or portable the whole world over, it was not very willing to listen to a proposal for a second standard. One of the greatest arguments against this new standard was that only projectors using standard films would be accepted, since there existed a voluminous list of available subjects. But when this list came to be examined in detail, it was discovered that it had little to offer the non-theatrical patron in the way of educational and religious subjects.

The Safety Standard film was finally introduced, of the same size as the Pathescope film and with a perforation which, while not infringing on the Pathescope patents, would enable it to be used on Pathescope projectors. Thus the Safety Standard film and the Pathescope film are interchangeable. As will be noted by studying the drawings in Chapter I, the Safety Standard has the same number of perforations along both margins while the Pathescope film has the same perforations along one margin and only every third one on the opposite margin, thus "framing" automatically in the projector. As already stated, however, both films are interchangeable, thereby giving a greatly increased scope to the Pathescope projector and films, as well as to all other Safety Standard projectors and films.

With the Approval of the Fire Underwriters

The adoption of the Safety Standard and Pathescope films by the Society of Motion Picture Engineers was a vast forward stride in the industry.



Special carrying case for the Pathescope projector. The reels of film are carried in a separate fibre case.

The clearly recognized hazards of the use and even the storage of celluloid film have not only been pointed out by the Underwriters' Laboratories, but

have been by them so insistently urged that not only the States, but practically all important municipalities have been compelled to surround the use and storage of celluloid films, within their jurisdiction, with such wise and protective restrictions as would tend to reduce to a minimum the hazards to which the members of the Commonwealth are constantly subjected in attending public and private cinematographic exhibitions.

The regulations calling for a fireproof booth, complicated and expensive standard projector, the services of a licensed operator, and other items have tended to retard the development of motion pictures in such fields as education, church and club entertainment, home use, and so on. This does not mean that there have not been and still are portable and semi-portable projectors intended for such non-theatrical use; but the fact remains that all projectors employing celluloid film should, according to the Underwriters' regulations and numerous ordinances, be used only in conjunction with fireproof booth, licensed operator and so on. To do otherwise is to nullify fire insurance policies and to break certain laws.

Yet schools, churches, clubs, homes and other non-theatrical users could not afford to go to the expense and trouble of complying with the regulations and ordinances, and so motion pictures have had to be left aside in the past, in many instances.

The obvious solution of the problem of hazard lay in the adoption of approved, slow-burning film, but the Underwriters' Laboratories again pointed out

that unless the portable projector should be so constructed that it would be impossible to use ordinary celluloid film therein, it was a foregone conclusion that in the absence of any considerable quantity of available slow-burning film the owners of such projectors would be sure to attempt the use of celluloid films therein—if such use should be possible—and the potential hazard would still remain exactly as before.

The new Safety Standard film and the Pathescope film have met with the specific qualification of the Underwriters' Laboratories and the National Association of Fire Prevention, which says: "Approved miniature projectors must be so constructed that they cannot be used with films employed on the full-sized commercial moving picture machine." Today the non-inflammable or slow-burning film and the projectors that handle it are approved for use anywhere, without fire-proof booth or licensed operator. This makes motion pictures available to everyone, anywhere, and at any time. At last motion pictures may be said to be a universal commodity.

Characteristics of Non-Inflammable Film

There is something like 30,000,000 feet of Pathescope non-inflammable film available today for Pathescope and other Safety Standard projectors, as well as other large quantities of Safety Standard film with the interchangeable perforations. There is no longer any fear that the projectors may have to remain idle for want of film and good subjects. Furthermore, the time is soon coming when there

will be even more extensive library facilities than there are at present.

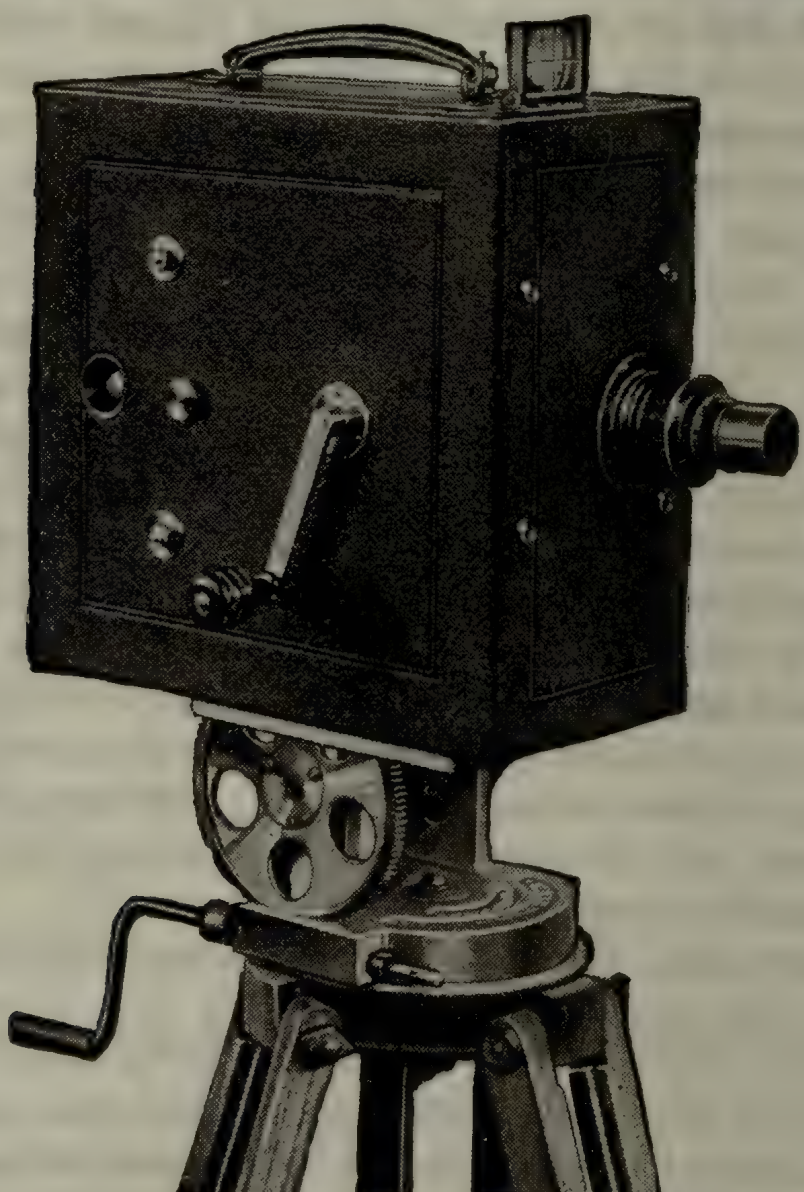
The Eastman Kodak Company has been furnishing the new Safety Standard film at 75 per cent. of the cost per foot for ordinary celluloid of standard width. Furthermore, the new Safety Standard narrow-width film contains twenty pictures per foot as against sixteen for the theatrical standard film. These two factors result in a combined economy or saving of 40 per cent. in the cost of stock for any given production. There is also, of course, a very considerable saving in the use of chemicals for developing, and also in the general handling and transportation of the narrow-width film, of which 800 feet in length is the equivalent of the ordinary 1,000 foot celluloid reel. Speaking of transportation, it is well to bring out the fact here that there are no restrictions or special regulations applying to the shipping or even mailing of non-inflammable film, whereas there are numerous and elaborate regulations applying to the inflammable standard films.

As for size, the difference between standard theatrical film and the narrow-width film is so slight that virtually nothing is lost in projection.

It is of opportune interest to note the recent incorporation of the Associated Manufacturers of Safety Standard Films and Projectors, which is composed, as its name implies, of the various manufacturers interested in the Safety Standard film industry. The Association will be able to accomplish much in the way of furthering the use of Safety Standard film and equipment. This is but one more proof that this

standard is well established and is a permanent institution.

There are two ways of preparing the Safety Stand-



The New Premier Pathescope Camera, which reduces amateur film photography to its simplest terms. This camera takes the narrow width negative film.

ard or Pathescope positives, namely, by filming a subject on narrow-width negative film and printing

by contact therefrom, or by filming on standard-sized negative film and then printing on to a narrow-width positive by reduction. Many laboratories, aside from the Pathescope and other laboratories specializing in Safety Standard film work, are now prepared to print standard negatives on to Safety Standard stock. The Pathescope Company have developed a Safety Standard film camera especially intended for amateurs. The film is wound on special spools and provided with light-proof paper ends in such a manner that they are daylight-loading, thus eliminating the complicated magazines or film retorts of the usual cinematographic camera. In every way possible the new Pathescope camera has been simplified so as to reduce motion picture photography to its very essentials.

Projection Reduced to Its Simplest Terms

Obviously, the employment of an inert, non-inflammable film renders projection a simple matter. Non-inflammable film, or call it slow-burning film if you prefer, will not burst into flame nor explode. If a match is applied to it, it merely melts and smolders, and the moment the flame is removed it supports only a feeble combustion. Hence the use of this film makes complicated fireproof magazines and fireproof shutters and other precautions unnecessary, which fact is reflected in the simplicity of all Safety Standard projectors.

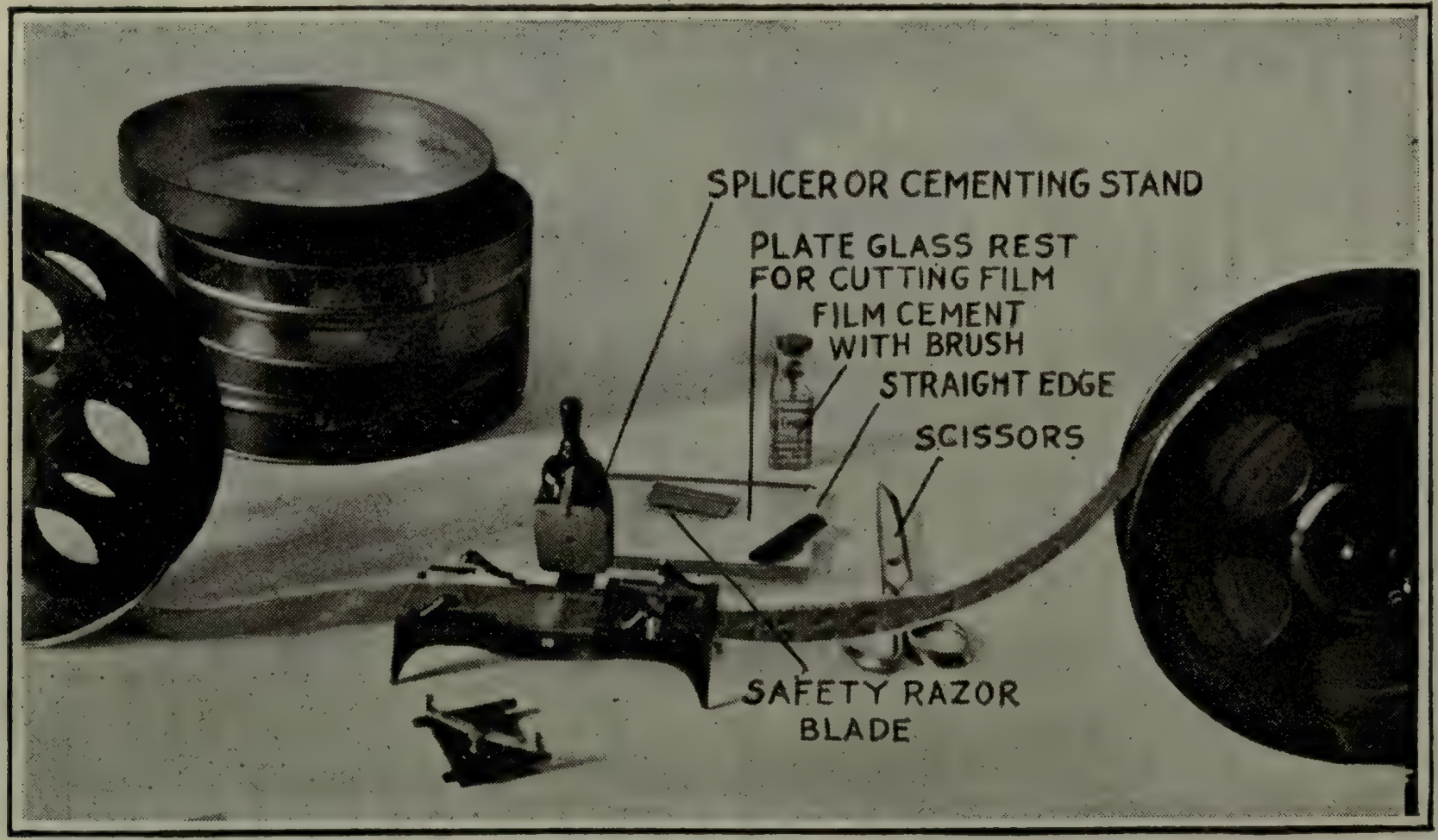
The new Premier Pathescope projector, with which the author is quite familiar, having used one for several years back, has all the advantages of a

standard theatre projector with none of its disadvantages. Indeed, it is little short of a boiled down standard projector, so to speak, with magazines and fire shutters and other safety devices left off since the fire danger has been eliminated at the starting point, namely, the film. The Pathescope projector can be taken down by folding up the arms that hold the reels, and made quite compact for carrying it about. Its weight is but 22 pounds, yet it projects a rock-steady picture when set up and placed on even a light table, because of the absence of vibration.

For the source of light, an argon-filled, condensed monoplane filament incandescent lamp is employed. A highly efficient optical system, combined with a novel eccentric star intermittent movement, makes for a remarkable degree of screen illumination in proportion to the actual light available at the lamp house. In fact, the Pathescope will fill a twelve-foot screen with a clear, well-illuminated picture despite its small size.

The Pathescope projector is motor-driven, being equipped with a small high-speed electric motor. Both the light and the motor are operated off any standard lighting circuit. Where the projector is to be employed for portable use, it can be operated from storage batteries and hand cranked if desired, or from a special hand-cranked generator.

Rewinding is done right on the projector in a simple and expeditious manner. In the latest model Pathescope projector the motor is disconnected from the main driving pulley and instead connected to the upper spindle pulley by means of a spring belt. The



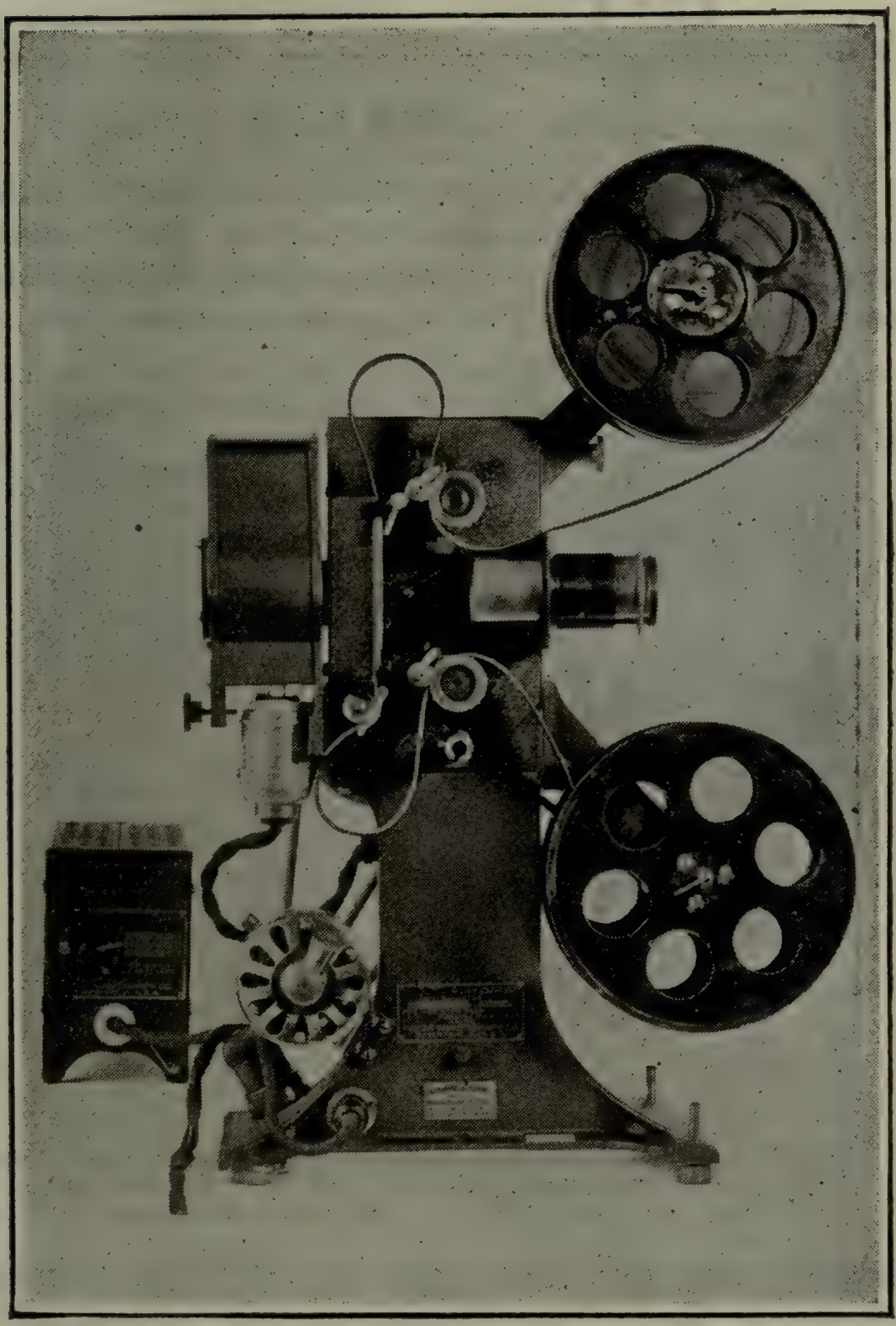
Film mending outfit used in repairing Pathescope or Safety Standard film. Such an outfit should always be at hand in order to mend film. This work is quite simple, the main requisite being neatness and due care.

film is then rewound from the lower reel back on to the upper reel, or to its starting point, so to speak.

The author has employed the Pathescope in his own home for several years, as already mentioned, and has never experienced the slightest trouble. This is quite significant in view of the intricate mechanism of the usual motion picture projector. He has had narrow-width films made of his children, both from Pathescope negatives and from standard-sized negatives, and these films have afforded no end of enjoyment to family and friends alike. In fact, nothing can compare with the joy of seeing one's children and one's self on the screen, especially with the rolling by of year after year. Half the pleasure of home "movies" consists of having one's own animated family album, and the other half in subscribing to the library service so as to have a complete change of film once a week or oftener.

While speaking of the Pathescope projector and films from actual experience, and therefore with positive authority, the author wishes to direct attention to other safety standard projectors now on the market. The Victor machine, while of a quite different design from the Pathescope, appears to be an efficient machine. It stands rather high, with the motor resistance in the hollow base. The shutter, instead of being placed in front of the machine, is enclosed in a casing.

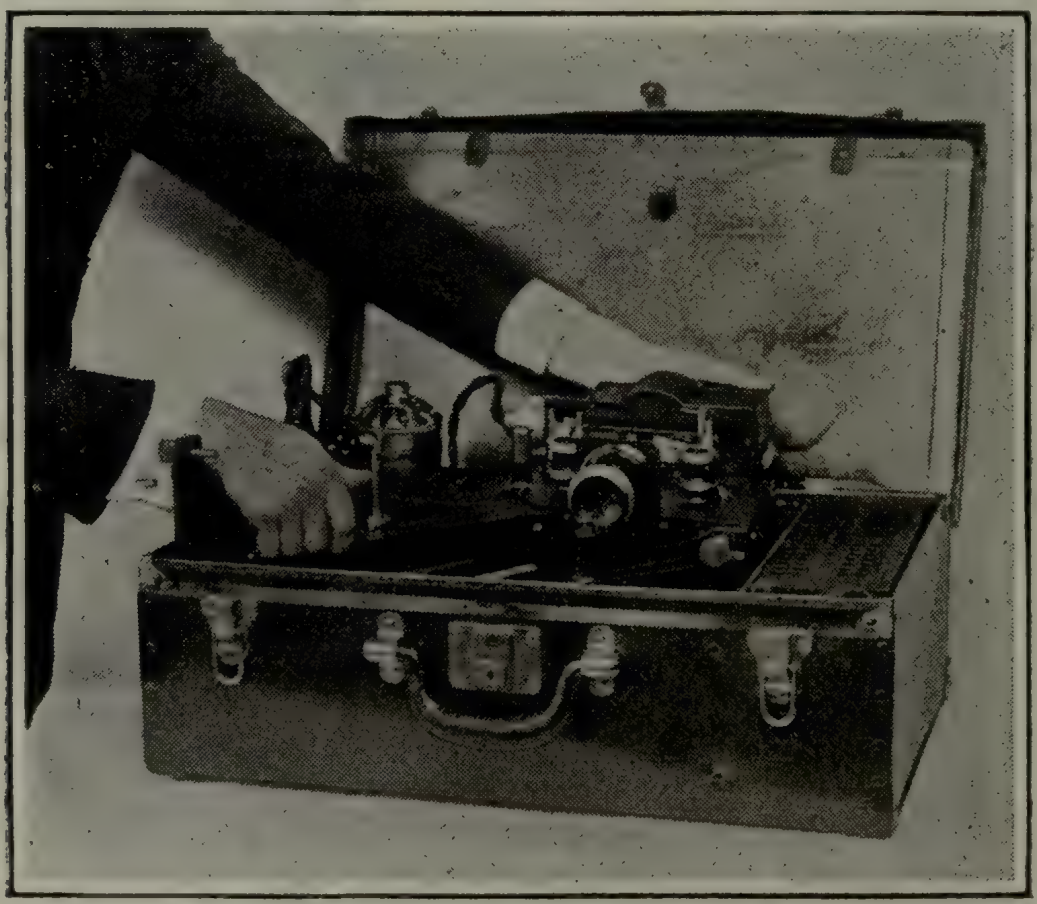
Another safety standard projector is the Cosmograph, which appears to be of neat design. Some of the suit-case projectors are also adapted to safety standard film.



The Victor projector, which is available for Safety Standard or Pathescope film. The shutter is enclosed in the casing of this projector, quite out of the way.

From Smaller to Still Smaller Images

A move in the direction of still smaller film than Safety Standard has come and gone from time to time, and at least one such effort has persisted, namely, the Movette. This system employs a slow-



Carrying case for the Victor projector. This machine is quite light and may be used by salesmen and others seeking a portable machine.

burning film of about half the width of standard theatrical film. The Movette system makes use of a camera of compact and simple design, which may be mounted on an ordinary camera tripod. The camera is loaded with daylight-loading film contain-

ers in a quite simple manner. The lens is of fixed focus and the operator has merely to line up the camera by means of the finder and then turn the crank. The negative is sent to a laboratory for developing and printing, and the positive is placed in a special magazine for projection. The projector, which is hand-cranked, appears to be of simple, compact design. The author has witnessed several demonstrations of Movette projection and in consideration of the small size of the film and the simplicity of the projector, the screen presentation is fair.

One thing in favor of Movette is its low cost. On the other hand, it is well to remember that, because of the small-sized film, it is limited to short throws and small screen dimensions. It cannot be expected to serve the same serious purpose as the Safety Standard and Pathescope systems employing larger film. Again, it is only within the past year or so that the Movette organization has introduced film subjects. Up till that time the Movette patron had to make all his own films, and his projector stood idle until a sufficient library was built up. Now there is a limited number of subjects available, although in no way comparable to the extensive offerings of the Pathescope and Safety Standard libraries.

Another attempt at the small film idea is the Actograph system, which is represented by a camera and a projector of small dimensions. Both these instruments have been designed by the same organization that produced the well-known Wilart cameras,

The Wilart professional camera and the Actograph amateur camera standing side by side. Note the contrast in size, yet both produce good motion pictures.

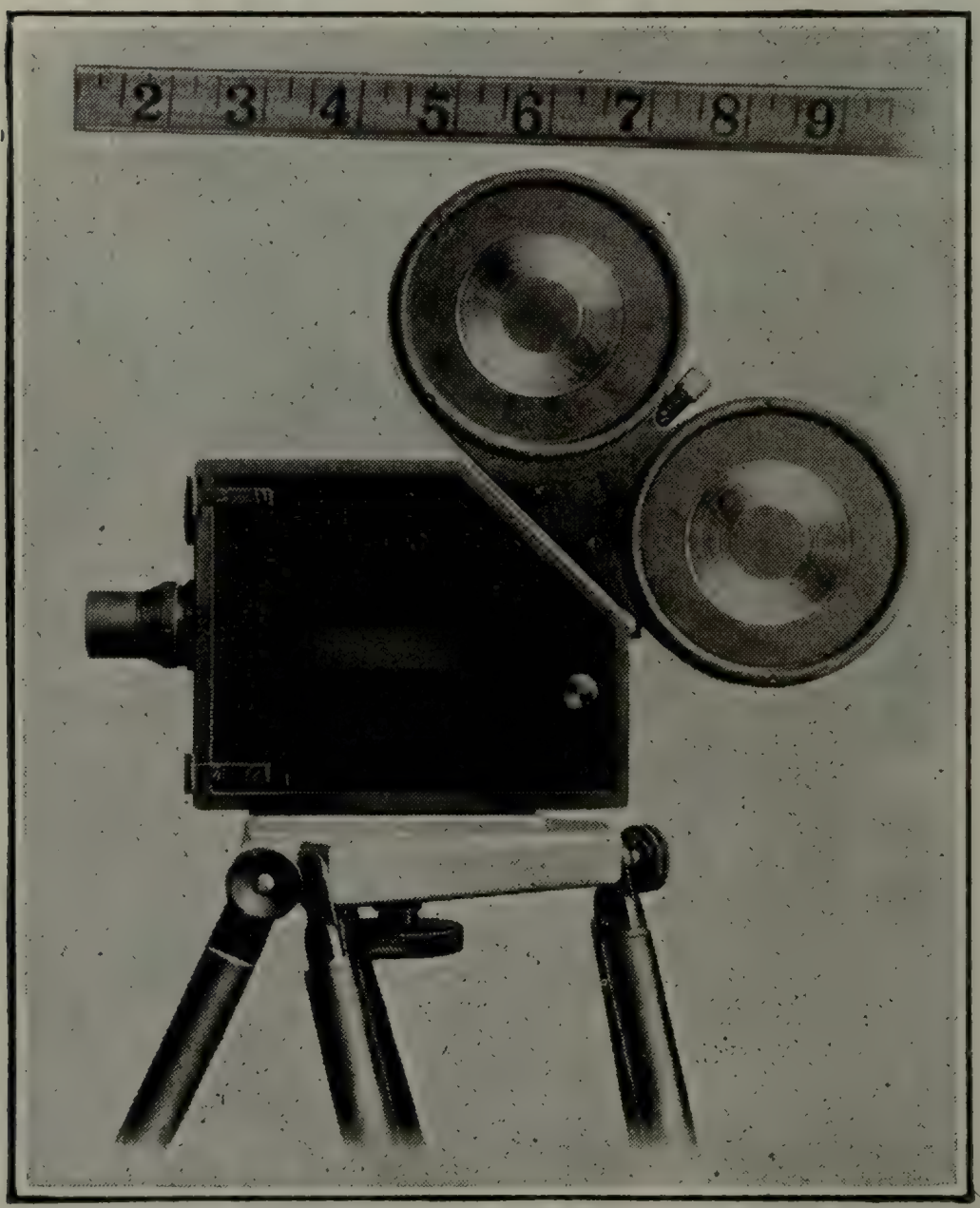
which must explain why they bear a certain resemblance to their bigger brothers.

Cinematographic Multum in Parvo

A good idea of the Actograph camera can be obtained by studying the accompanying illustration. The claim that the Actograph projector gives as good

The Actograph camera for amateur purposes. This tiny camera makes use of small films intended only for a very limited throw.

projection as the usual standard portable machines, and at a distance of 18 feet it gives a picture 3 by 4



Another view of the Actograph camera, with a foot-rule to indicate the relative size.

feet. It will be noted that the film, which is considerably smaller than Pathescope or Safety Stand-

ard, is contained in a double magazine which fastens on to the rear of the camera, as shown. The camera case, in turn, slides into a slot provided in the simple tripod head. The film is readily threaded over the simple sprockets, and an outside spring belt takes care of the take-up. The crank can be arranged for the usual eight-pictures-per-turn movement or the single- or trick-movement. The finder lens is directly above the photographic lens. The photographic lens is of the fixed focus type and is universal from three feet on.

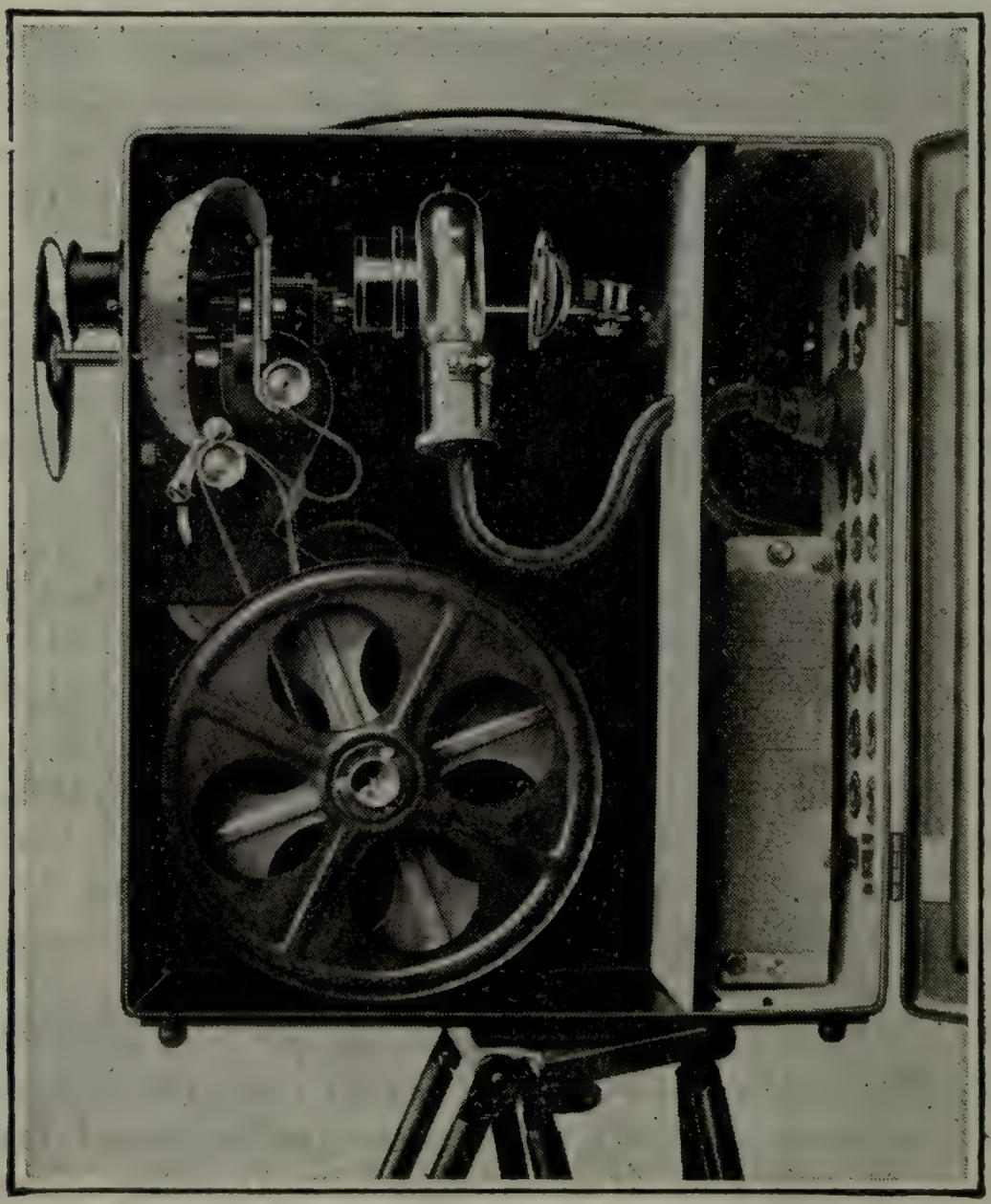
The projector, on the other hand, is of the suit-case type, so to speak, with everything contained inside a case. The entire projector weighs but nine pounds, which makes it a convenient outfit for salesmen. It can be set on a tripod, if desired.

The small sized film of the Actograph system results in a marked economy. It is claimed that the cost of prints is about one-quarter that for standard prints. However, in view of the small size of the images it goes without saying that the Actograph system is suitable for such industrial uses, churches, schools and especially home use, where the throw and the size of the image are not excessive. Any standard negative can be reduced to an Actograph film.

The mechanism of the Actograph projector appears quite plainly in one of the accompanying illustrations. It consists of a small high-power incandescent lamp which is operated from a standard lighting circuit through a suitable resistance, a mirror, condenser, film-handling mechanism, lens, and external two-

bladed shutter. The film being of the non-inflammable order, no enclosing magazines are required.

Another miniature system of motion pictures is the Sinemat, in which the camera mechanism is used



The Actograph projector, which is mounted on the same tripod as that used for the camera. The positive film is of the slow-burning, safe kind.

interchangeably in the camera and the projector, to reduce cost. The film is made by taking standard film and splitting it in half, then obtaining a narrow-width film with perforations along one edge only. The positive is made from slow-burning stock to ensure safety.

Disks, Glass Plates, Paper and Whatnot

Film will always be expensive, albeit it may always be the sole means of obtaining suitable motion pictures. Still, we cannot accuse inventors of not trying in every possible way to give us some other means of motion pictures than the film one.

Thus from time to time a disk arrangement has been re-introduced for amateur motion pictures. These disks, made either of glass or slow-burning material, with the images arranged in spiral form, are inexpensive to produce and quite simple to handle. In fact, the processes involved in producing such disks in quantities are quite analogous to the production of phonograph disk records in point of preciseness and dispatch, making disks a commercial proposition of the first order. But disks have their limitations from the standpoint of final results. Due to the small size of the images, such devices are generally designed for very small throws and quite small screen images. There cannot be much detail in the screen showing. Then again, the number of images, even despite their microscopic size, that can be placed on a single disk, is so small that only short bits of action can be presented. The presentation of a real film story is quite out of the question. It seems

Why not carry a motion picture camera on the motor tour? Here is the tiny Actograph camera mounted on the windshield of a car, ready for instant action.

that such apparatus is rather in the nature of a toy than a serious attempt at motion pictures.

Several schemes have been worked out and introduced from time to time utilizing glass plates and even large pieces of slow-burning material, with the images arranged in rows. The projection in such cases calls for one image after another in one row, after which the optical system picks up the next row and so on. Such systems, while highly ingenious and representing a low cost of operation, are usually incapable of projecting the steady, clear pictures that are obtained with the regular run of film projectors.

Then again, paper has been used—paper ribbons with the images printed in the usual way. A reflecting principle is employed for projecting the opaque images. The fault here is merely a matter of securing sufficient reflection and illumination for the screen. Paper is certainly cheaper than the usual film materials, and its wearing qualities are fair. But the matter of securing sufficient illumination on the screen is such as seriously to limit the application of paper projectors.

In one ingenious form of paper ribbon system the inventor made his projector in the form of a cabinet, with a shadow-box, so that only a short throw and a small screen were necessary. Such a cabinet can be placed in a corner of the living room and the pictures viewed by a small gathering. It appears that this idea gets away from the objection of paper ribbon motion pictures, since the limited amount of light is compensated by using a small throw and a very small

screen. But as already stated, the paper ribbon is very limited in its application, and it is problematical whether it has a real commercial value in the long run.

Be all that as it may, the fact remains that the acetate of cellulose film has proved the greatest boon to motion pictures. It has made motion pictures safe. There is no longer a technical excuse for not going ahead with visual education in our schools and churches, and for motion picture entertainment in the home quite on a par with our phonographic repertoire of the world's best music.

Chapter XIV.

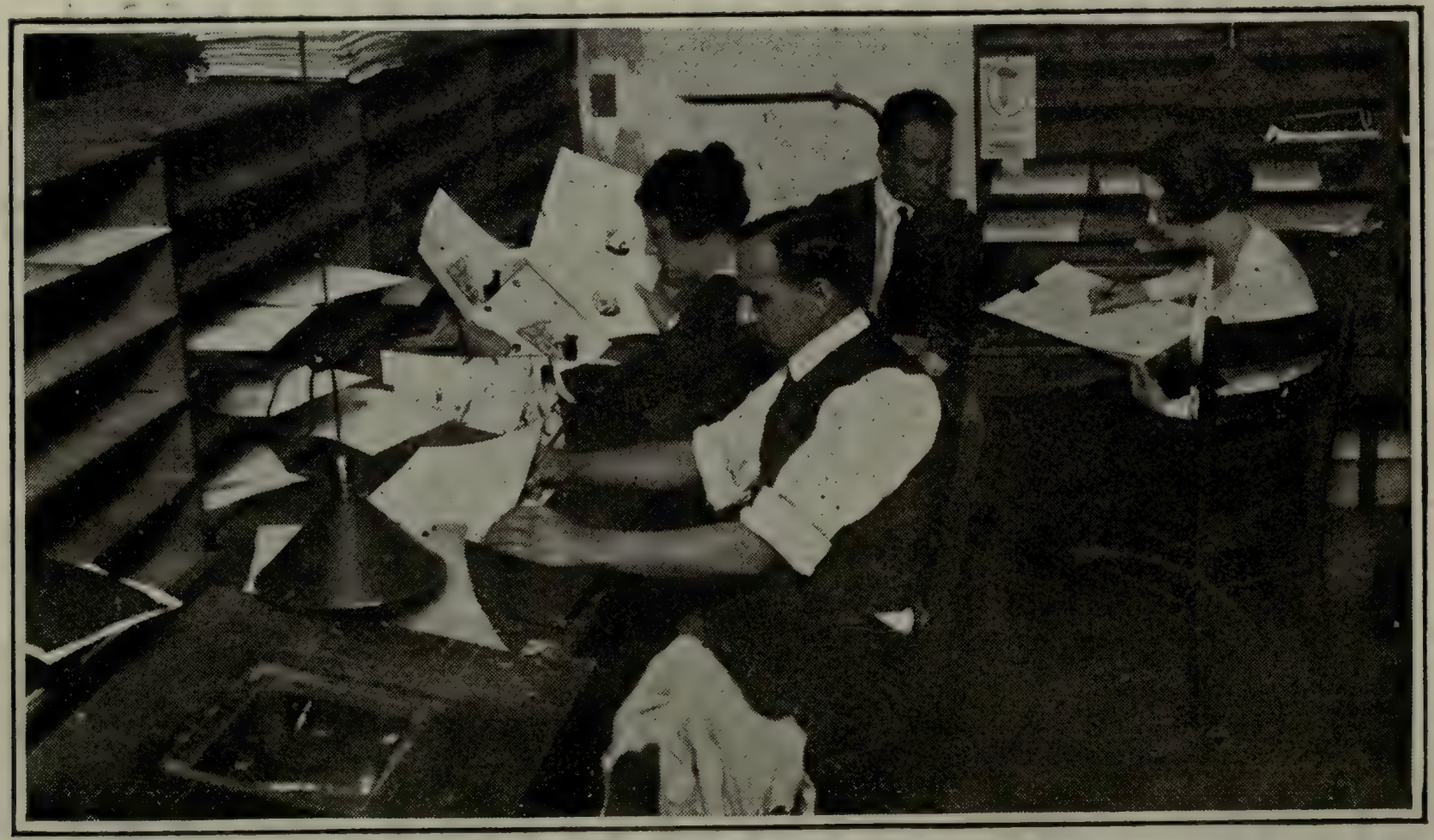
SPECIAL APPLICATIONS OF MOTION PICTURE PHOTOGRAPHY

AS the reader must no doubt know by now, the usual motion picture camera is provided with two movements, namely, the usual movement or cranking shaft, which exposes eight pictures or ½ foot of film for each turn, and the single-picture or trick cranking shaft, which exposes but one picture or frame for every revolution. There is virtually no end to what can be done with the single-picture movement, although, unfortunately—and perhaps fortunately, after all—there is little to say regarding these various effects except in a very general way. Animated cartoons, animated models, trick pictures in general, films showing the growth of a flower in a few minutes' time—all these things are more or less jealously guarded secrets, so the author will have to speak more or less in generalities, leaving the mastering of the details to the resourceful and inventive reader.

With One Picture at a Time

The basis of animated cartoons, animated models or so-called mechanigraphs, animated sculpture and so on is the fact that one frame can be exposed at a time with the usual motion picture camera. To illustrate, if the cameraman wishes, he can show an ani-

mated chair in a very simple manner. All he has to do is to set up his camera, then take, say, several feet of film in the usual manner, showing the chair at rest. Then he stops the camera, transfers the crank to the single-picture or trick movement, and either he or an assistant moves the chair, say ½ inch, in the desired direction. If the chair is moved more than that distance, it will result in faster movement when the film is projected on the screen. In fact, how far and how often to move any given object depends on the object, the distance away from the camera, and the desired screen speed. All these factors have to be solved in each individual case, and that requires considerable experience. At any rate, if the chair is moved, say ½ inch, the person gets out of camera range and an exposure is made by turning the crank a single revolution. Then the chair is moved another ½ inch, and another frame is exposed, then another ½ inch of movement, and another frame, and so on. Of course, this is slow work. It requires almost endless patience. But highly interesting screen results may be obtained in this manner. Some small producers have made considerable money merely by animating dolls, teddy bears and so on in this same manner. The work is not so difficult, once the cameraman has mastered the details and knows something about animation, which seems to be a definite branch of cinematography by itself. Where real difficulty arises is when the animation extends to a number of subjects which must be animated simultaneously and at different rates. The animation of a doll and the action of a man in the same scene, for instance,



Animators at work in a studio specializing in animated cartoon productions. Thousands of drawings must be prepared for an animated cartoon film. The girl at the right is keeping a record of the sequence of the numbered drawings.

calls for great deal of care and patience. The man must move ever so slowly in order to keep in perfect step, so to speak, with the animation of the dolls.

The Animated Cartoon in the Making

Because the animated cartoon, which is so well known in our present-day motion picture programs, tells its story by means of drawings, its production is a matter of preparing thousands of drawings in order to carry out the creator's idea. The animation of a picture calls for a collection of separate drawings, each a trifle different from its predecessor so as to present progressive action; and it is in knowing just how different to make the successive pictures that much skill and experience and real ingenuity are called upon. This, the all-important task, is usually entrusted to one who is the master artist, in a studio specializing in this class of work, the other work being relegated to a large staff of assistants.

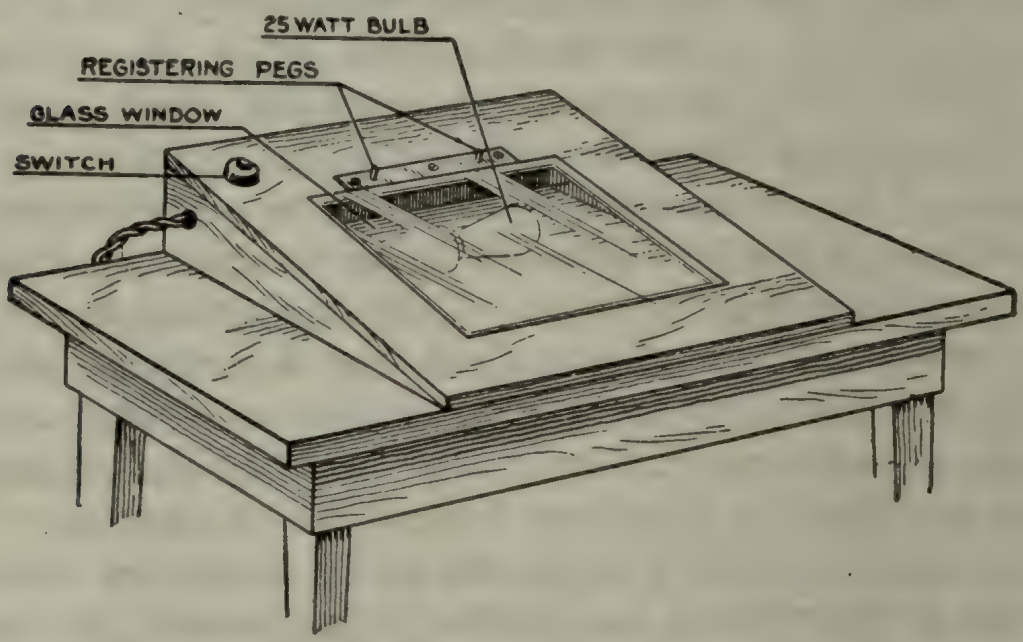
The various backgrounds of an animated cartoon are drawn but once wherever possible, for it would obviously involve a great volume of unnecessary work if each drawing included its own background. On the other hand, the moving figures must each be drawn over and over again in progressive positions, with each successive drawing slightly different in order to convey the proper illusion when flashed rapidly on the screen in the proper sequence. The sheets, on which are drawn the animated objects, are used in conjunction with the different backgrounds so as to make a complete cartoon when properly assembled one

over the other. Sometimes the background or the figure or part of the figure is in the form of a sheet of transparent celluloid, especially if the animated figures are to pass back of the objects pictured on the celluloid, or keep in the center of the picture, free of the scenery, or only a part of the figure must be animated, the rest remaining stationary. More generally, however, the background is in the form of a border covering certain parts of the sheet carrying the animated objects. Often the latter are cut out more or less so that the figures can be made to overlap portions of the background, so as to give the appearance of passing in front of the background.

Considerable artistic talent and knowledge of motion are requisites in the proper and successful animation of a drawing, despite the seeming simplicity of the cartoons as they are viewed on the screen. The movements of the characters in an animated cartoon must be convincing and at the proper speed. If a man is walking down a street, for instance, the animator must know how many sketches are necessary to have his character cover the distance at the proper gait. If he uses too many sketches, the picture lags; if he uses too few, the movements become very jerky and quite trying on the eyes of the audience. It is therefore necessary for the animator to know how to make each drawing with relation to its companion sketches; and his is the art of indicating the difference between one drawing and the next with a few bold strokes of his pencil, leaving the detailed finishing of each drawing to other members of his staff.

The animator works on an unusual easel, consisting

of a slanting piece of frosted or ground glass held in a suitable frame and through which pass the rays of an electric lamp placed below it. The simplest form of such an animator's easel is shown in the accompanying sketch. Thus it is possible for the artist to lay a clean piece of paper over the last drawing and

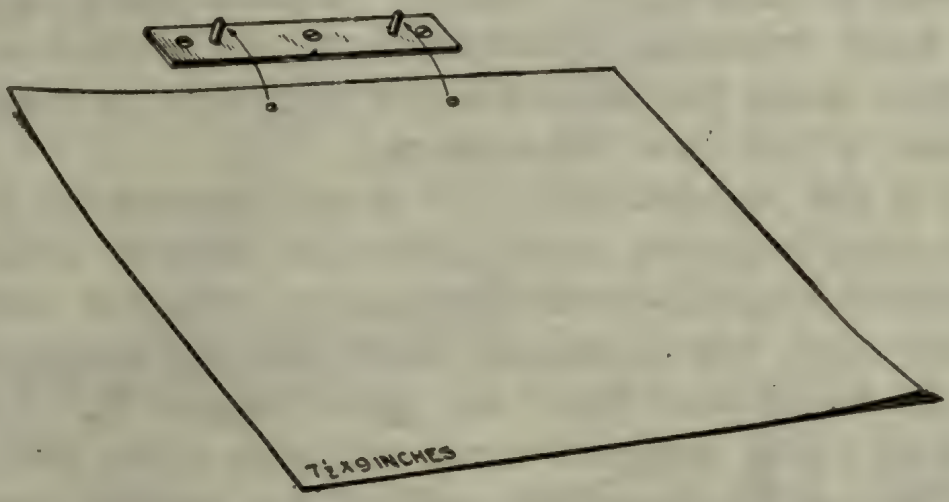


Simple home-made easel with electric light shining through a glass rest, which may be used in making animated cartoon drawings.

indicate on the blank piece the new or progressive lines for the animation. And by rapidly waving one end of the new drawing while it is still in place over the preceding one, he can tell at a glance the extent and correctness of the animation. The drawings are made on sheets of paper of suitable size, 7½ by 9 inches being considered a good working size.

Perfect register is a vital consideration in the preparation of animated cartoon drawings, because of the great magnification of the films on the

screen. The simplest way to obtain perfect register of all sheets is to have the sheets perforated with two or three holes along one edge, and to use metal pegs corresponding to these holes on the easel. In this manner every sheet fits precisely over the same field as



Perforated sheet of paper and registering pegs used in making animated cartoon drawings. The same arrangement of pegs is used in the camera stand.

any other sheet. The same system of pegs is employed in the animating stand, where the sheets are photographed.

A Matter of Clear Understanding

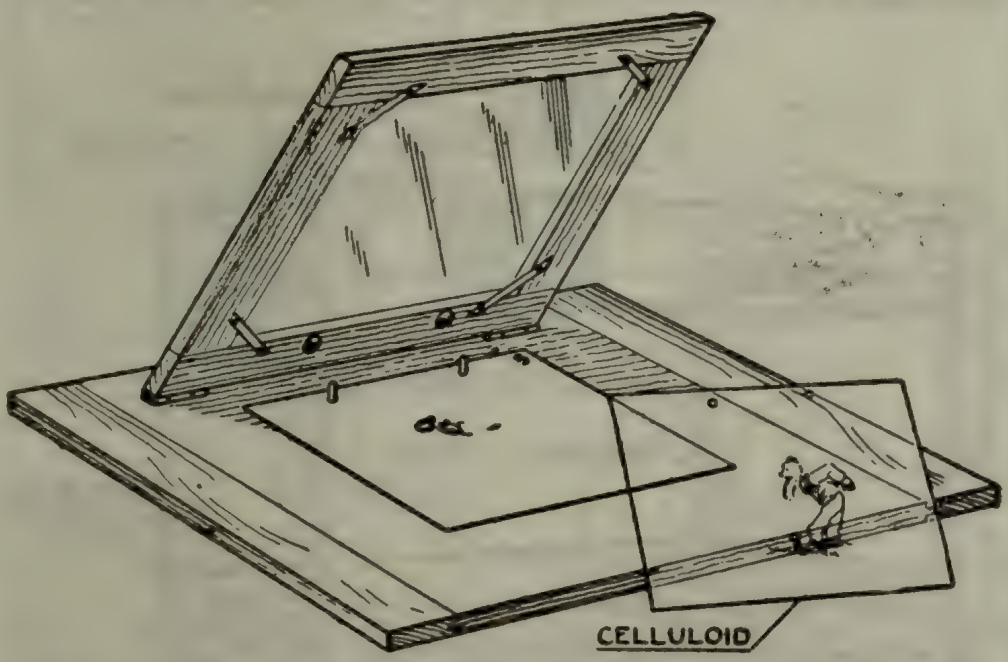
A considerable amount of thought must be devoted to the audience's understanding of the picture. The center of interest in a cartoon must always be played up prominently by the simple procedure of subduing other features. For instance, if one of the characters throws a missile, it is necessary that there be no further movement of the arm after the missile begins to travel across the picture. The character—and every

other character in the drawing, for that matter—must remain absolutely rigid so that the attention of the audience will not be distracted from the missile which at that moment is the center of interest. Then again, when a character is made to speak by the introduction of what is known as a "balloon" within which appears the hand lettering, there must be no motion in the cartoon until the audience has had time to read the legend, which then disappears.

It is the preparation of so many progressive drawings that requires time. After the master artist or animator has indicated the changes from one drawing to the next, his assistants work out the drawings in detail. Sometimes these are quite simple and can be done in a few minutes' time, while in other instances they are quite involved, calling for special shading and even special tints or wash, in order to cut down the glare when shown on the screen. There are no definite figures to indicate the quantity of animated cartoon work that can be turned out in a week, since this depends as much on the elaborateness of the work as it does on the worker. Suffice it to say, however, that a well-known cartoonist turns out on an average about one hundred feet of film per week.

The photographing of animated cartoons is a simple matter, so to speak. It is accomplished by using a motion picture camera mounted on a substantial wooden or metal frame, with the lens pointing straight downwards. A framing or registering device is placed on the table directly below the camera, this device being provided with pegs or other device to correspond with that used in the easel in which the drawings

have been made. Sometimes a sheet of glass must be laid on the drawings to make them lie perfectly flat. Suitable lights, preferably mercury vapor lamps, are mounted on each side of the table to supply the necessary illumination. A simple outfit for photographing



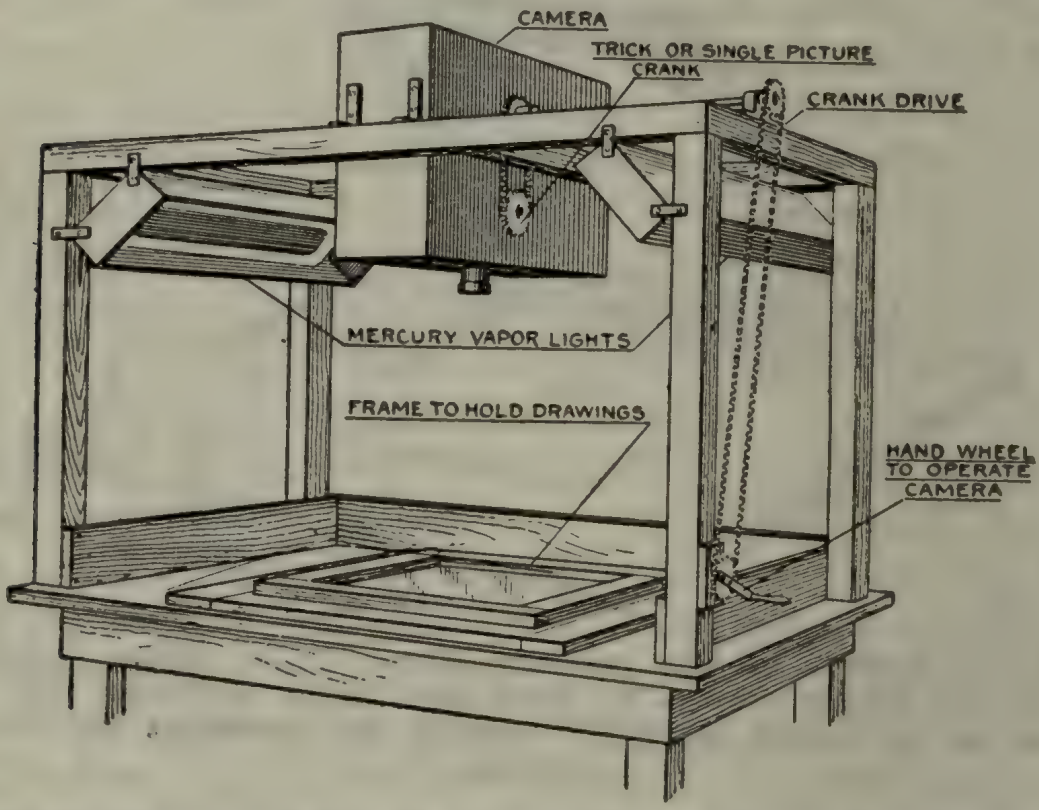
Sheet holder of the camera stand. The glass sheet in the frame serves to hold the paper perfectly flat, so as to avoid shadows caused by wrinkles in the paper.

animated drawings, which is called an animating stand, is shown in the drawing on page 444.

Now the camera may be operated by hand, if the operator can spare the time to turn the crank one revolution each time a picture or frame is to be exposed. This method, aside from being tedious, also calls for a uniform turning of the crank in order to obtain even exposures. However, if the amateur cinematographer is anxious to go into this line of work on a serious scale, he should have his camera equipped

with a motor drive and positive clutch arrangement, which turns the crank one revolution every time a button is pressed, the motor operating all the while.

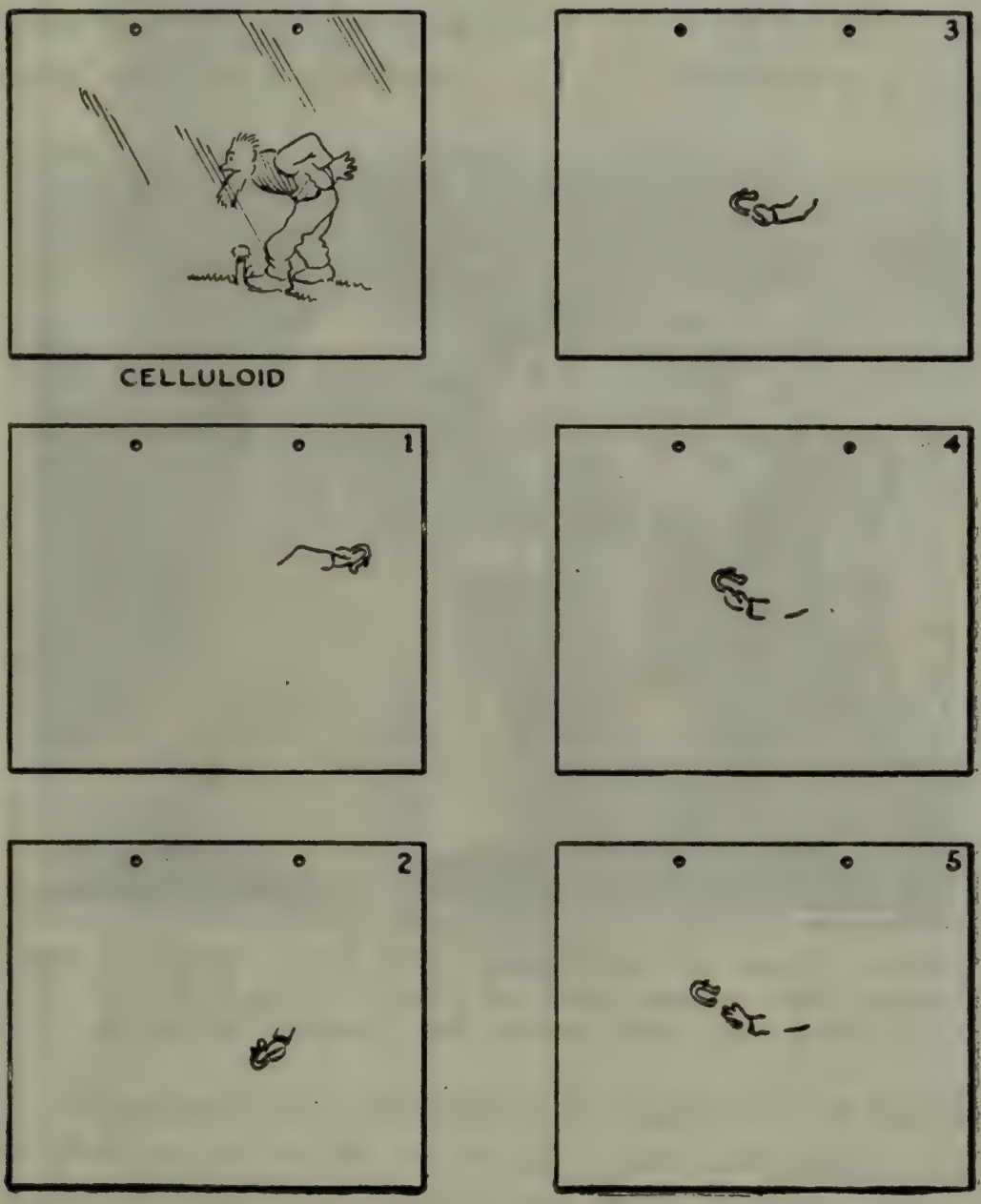
By the clever manipulation of a set of drawings it is sometimes possible to avoid making a large nunmber of drawings for conveying a certain idea. For example,



Typical camera stand for making animated cartoons. This stand is of the simplest design and may be constructed by the handy man.

a long freight train moving past one point may be represented quite nicely by a drawing of a locomotive and tender and several freight cars, after which the same freight car drawings are repeated over and over again until the desired length of train has been represented. Or if a figure is shown doing the same thing for a few seconds, such as jigging or exercising or run-

ning in a circle, it is only necessary to draw the complete action once, after which the same set of drawings is used as often as necessary. These measures, which



The principle of time-saving in animated cartoon work. Note that the celluloid sheet carries the drawing of the little man, while the accompanying paper sheets carry only the action of the arm and horseshoe.

are in reality short cuts, go far to reduce the amount of work and the time required in producing a cartoon.

With the completion of the drawings, it is necessary to draw up a schedule of the order of the filming and how it shall be done. This schedule gives full details as to the sequence of the pictures, how they are as-

Scene from an animated doll film. This is the most interesting kind of trick work, and the results are well worth the trouble involved.

sembled in the case of celluloid transparencies, how many exposures for each, when fade-ins or fade-outs as well as vignettes are called for, and so on.

All these facts are only given in order that the reader may have some idea of how the work is done. The author feels that in the limited space here avail-

Producing an animated doll film. The dolls must be animated by slight changes from one exposure to the next, all the work being done with the single picture or trick movement of the camera. If anything, this work is even more time-consuming than animated cartoons.

able it is impossible to go into details, for this subject is highly intricate and requires a good deal of study for successful results. He therefore recommends the very excellent and ably handled work entitled *Animated Cartoons*, written by Mr. E. G. Lutz, which covers the subject in detail. The present facts are merely to give the reader a foundation in order that he can intelligently take up this matter with firms specializing in such work when he wishes to have cartoon films made.

Screen Comedies in Clay

Possessing every feature that goes to make a good comedy on the screen, and having in addition a distinct note of novelty, the animated sculptures introduced several years ago have proved a pleasant change from the usual run of film subjects.

The principle of the new films is precisely that of the animated cartoons: the photographing of successive subjects or positions of the same subject, each a trifle different from its predecessor so that the proper animation will result when the strip of film is projected on the screen. The exposures or frames are made one by one.

Like the production of animated cartoons, the making of animated sculpture films is something that cannot be undertaken without some preparatory study. It requires months of experimentation before the results obtained are satisfactory.

The work of the animated sculpture producer runs about as follows:

First, the film story is worked up, much after the

Animated sculpture in the making. The same principle as in animated cartoons and dolls applies here. The tiny statues, made of plastic material, are slightly varied from one exposure to the next. Unusual and striking results are obtained in this manner.

fashion of the regular scenario, although of course the plot is simple and the action is reduced to a minimum. Then the cast is assembled in the form of the required number of clay figures. As far as possible these figures are made entirely of modeling clay of different shades, painted when necessary to make them more attractive. Occasionally the little figures are dressed in real clothes and have real hair. When the design is mechanically weak, the clay is reinforced with wood or wire.

The little clay figures are placed in front of the camera and filmed in the usual single-picture manner. That is to say, one frame is exposed, and the figures are moved say ⅛th of an inch; then another frame is exposed, followed by another slight movement of the figures, and so on. The extent of the movement in each case depends on the speed desired on the screen, and is a subject for experience and study.

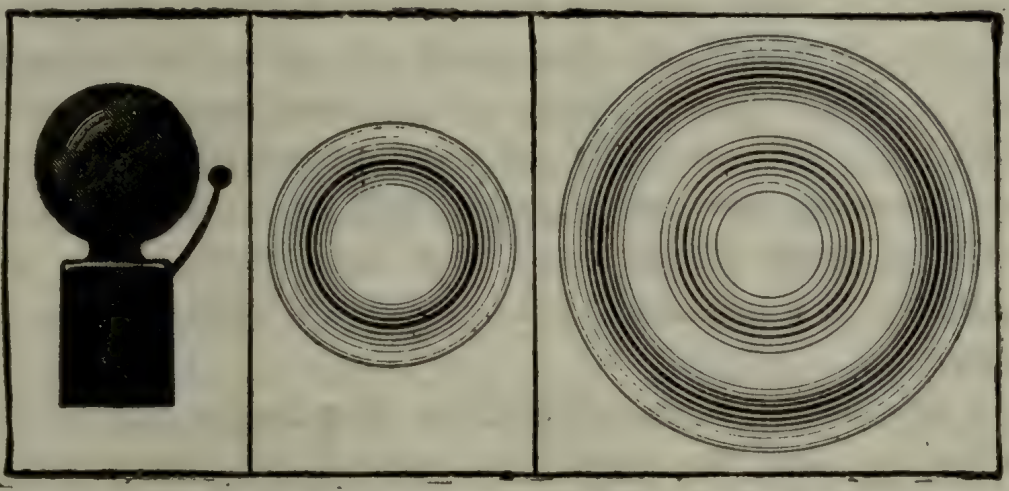
Dolls, toys, and letters for a title or other reading matter, parts of any device and so on can be animated in about the same way. In fact, most of these things are relatively simple compared to animated cartoons, and are well within the means of the average amateur cameraman.

Animated Technical Drawings to Give Instructions

A strip of celluloid is transforming modern educational methods. Heretofore, the school teacher has had a three-fold problem to face. Every educational method tries to arouse the pupil's curiosity, stimu-

late his interest and free his imagination. To obtain results, the teacher has only the five senses of his pupils to play upon. These are the channels of learning, with the visual sense by far the most active in the absorption of information.

The difficulty of the instructor's task is not only a psychological and a biological one, but is also compounded by a practical obstruction. The student may be temperamentally prejudiced against a par-



How the sound waves from an electric bell can be shown in animated drawings. The bell is painted in wash on cardboard, while the drawings, such as the two shown, depicting the sound waves, are made on celluloid.

ticular subject. So may the teacher; and as a consequence his lecture may not be stimulating. Moreover, both the child and the instructor have their "off" days, on which the learning process halts almost completely. Furthermore, the mechanical aids of teaching may be inadequate. It is an indictment of our entire public school educational system that the leisurely methods and the scientific aids now in use in some of the best equipped elementary private

schools in America are unknown in the public schools. Besides, the present dearth of instructors, not to say good instructors, presents a practical obstacle which the very best of educational methods will find it difficult to overcome.

But an entirely new method is gradually attracting the attention of educational boards. With it no subtle effort on the part of the instructor is needed to arouse the pupil's interest or to stimulate his curiosity. This is due to the fact that it aims at instruction through the medium of entertainment. That is what the modern educational motion picture is doing. The making of the educational film has gone through several phases; but an experiment successfully tried during the war has proved the practicability of making this type of film by a new process.

At the West Point Military Academy, previous to our entry into the war, the manual of instruction on the constitution and operation of bombs was supplemented by a lecture course of twenty-four teaching hours. The Government commissioned Lieut. F. J. Leventhal to make a picture of the processes involved, with the result that the course was reduced from twenty-four hours to fifteen minutes.

This new type of educational picture is called the animated technical drawing and is a development of the animated cartoon. The process by which these films are made consists of photographing about 1,500 individual drawings and explanatory titles on a roll of motion picture film. The drawings are made on thin paper and then traced on transparent compo-

sition plates. These plates are numbered and exposed to the camera in succession. As in the motion picture taken from life, it is often necessary to emphasize certain phases of the subject. Moreover, the same drawing may be used in several places to tell the story clearly. This is comparable to the use of what is known in motion photography as "flash-backs." In the animated technical drawing the result is achieved by photographing the drawing desired in its regular numerical order and again inserting it at some later point in the picture. For example, drawing number 9 may be shown as the ninth picture on the reel, and may again appear in forty-fifth position when the reel is completed.

In photographing the transparent plates, it is often necessary to superimpose two or more of them and photograph them together. This is necessary to obtain the illusion of movement. It also obviates the necessity of making an indefinitely larger number of drawings than are now used in a single animated technical drawing.

The principle on which this phase of the work operates is based on the fact that several pictures are alike except for minor changes. If a flower is to be represented as blossoming, the stem remains the same throughout the process. Consequently, a transparent plate showing only the stem is photographed as a background with a succession of other drawings that reveal the stages of the blossoming process. This results in a great economy in the number of drawings to be made, as well as in a saving of time. In fact, if this idea had not been reduced to an

economically scientific basis, the so-called technograph drawings that have been developed would not be practicable.

Drawings Made Up of Backgrounds and Transparencies

In all the subjects several dark-toned backgrounds are used with the transparent plates. An instance of this may be seen in a physiological study showing the action of the human heart. The heart is first photographed from a dark cardboard background; then a transparent plate on which the chambers of the heart are drawn in outline is superimposed, and the two drawings photographed together. Several other plates showing changes in the chambers are then laid over the background and photographed. Of course, several different backgrounds are used; but a single one is often combined with as many as twenty or even thirty transparent plates.

Interspersed with the animated drawings are titles; and, when necessary, a pointer is introduced to draw attention to something that is to be emphasized. Up to the present time, a fairly complete library of scientific subjects has been prepared. Even text books are being "animated" by this process. Within a comparatively short time, as educational developments are reckoned, it is certain that catalogues and libraries of pedagogical films will spring into being and vie with our public book libraries. Then it will be a simple matter for a school to order a series of films on any subjects desired. These will of course be returned within a few days, as entire

courses of study can be clearly outlined to students by the motion picture method in a very short time.

Furthermore, subjects formerly taught in colleges are now made understandable for children of ten. And it is now possible for the man-in-the-street to fill in many gaps in his incomplete education by seeing the animated technical drawing in the regular motion picture theaters.

Astronomy Made Simple for the Man in the Street

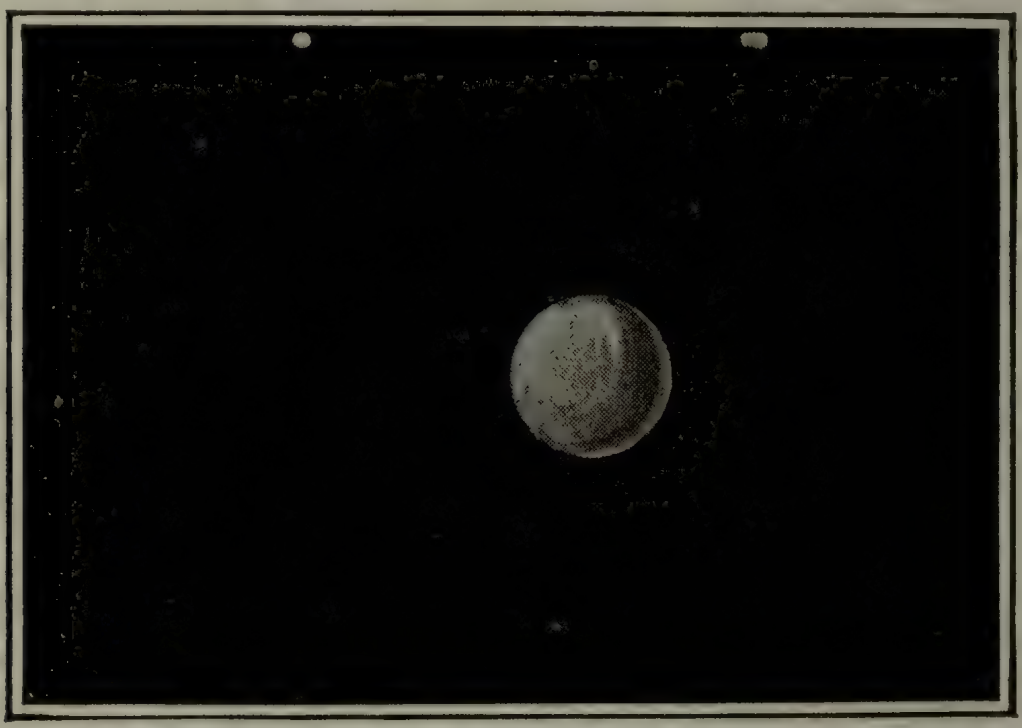
Even astronomical phenomena have been portrayed by the animated technical drawing. The effect of the moon on tides is exposed in a simple way. A series of moving arrows between the earth and the moon pictures the pull that the latter exerts on the former. The force is similar to magnetism; and this comparison is shown by replacing the moon by a magnet, showing the water rising from the earth's surface in response to the pull of the magnet. When the magnet is replaced by the moon again, the phenomenon has been perfectly explained. This attraction of the moon for the earth's waters is shown in action on opposite sides of the earth's surface. The explanation is conveyed in a title:

"The opposite side of the earth will have high tide at the same time because the earth itself is drawn towards the moon away from the water."

The reason for low tide follows inevitably. How two tides a day result from the revolution of the earth is shown in the same graphic way that high and low tides are explained. Perhaps the most in-

teresting phase of this educational picture explains the difference between spring tides and neap tides.

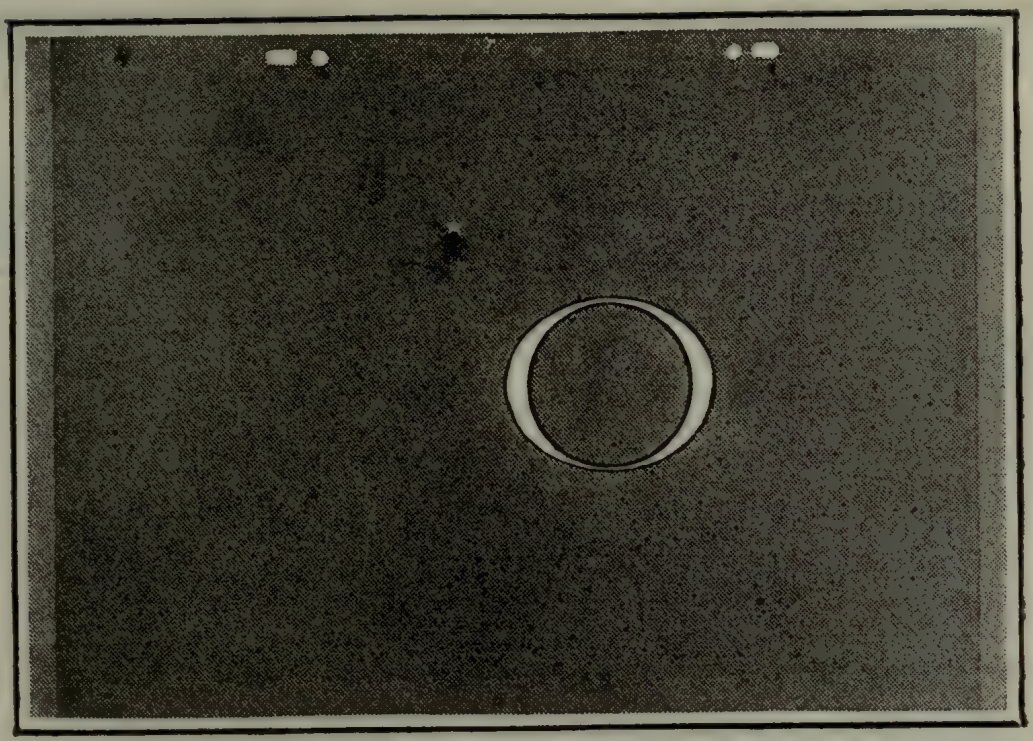
In spring tides the position of the moon is directly between the sun and the earth. Consequently, the double pull exerted by them results in extremely high tides. However, when the sun and the moon are



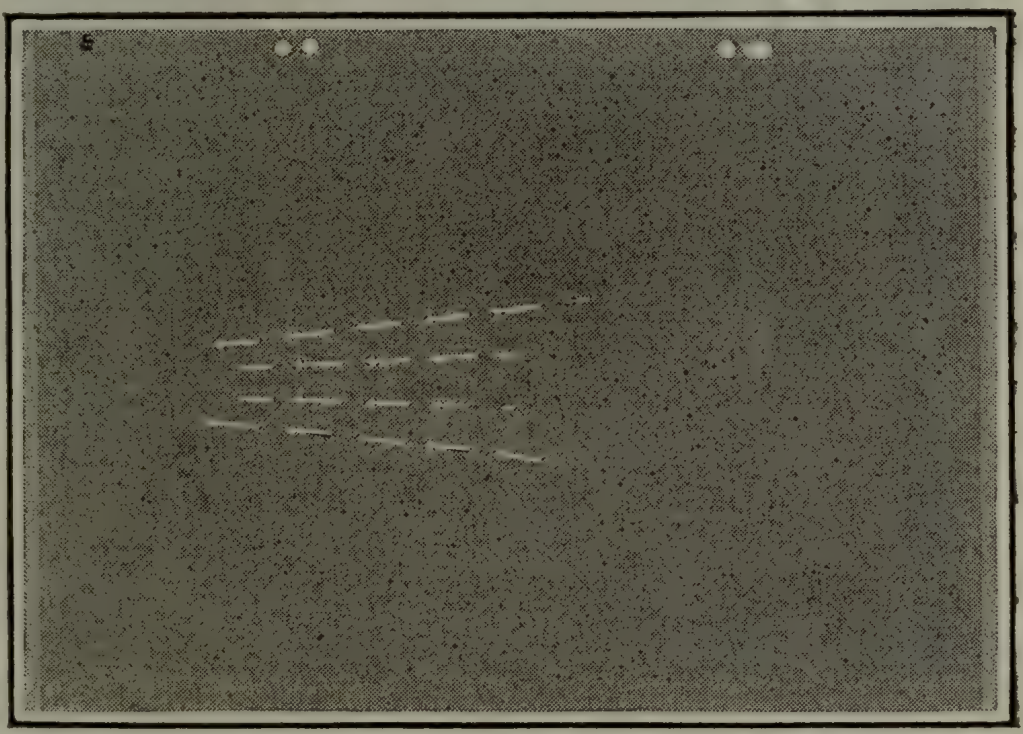
This drawing, and the drawings shown on facing page, depict how an astronomical feature may be brought out on the screen. The drawing here shown is painted on a black background, and forms the basis for the scene.

at right angles to the earth, the pull of the moon is somewhat diminished by the attraction of the sun. When the earth is in this position, with reference to the sun and the moon, we have what are known as "neap" tides.

Instruments for indicating as well as for predicting high tides are carefully explained. At the con-



Drawing showing how the moon's influence causes the earth's tides. This drawing is made on celluloid, and is photographed when superimposed on that shown on facing page.



Another drawing of this series, this time showing the arrows that indicate the gravitational pull of the moon on the earth. This drawing is also made on celluloid and is photographed when superimposed on that shown on facing page.

clusion of this animated technical drawing, the subject has been quite thoroughly presented. In fact, any child is able to follow the "story" because it is constructed on sound pedagogical principles. All the animated technical drawings begin with a phenomenon that is common everyday knowledge; and by adding fact to fact and by making intelligent use of the process of analogy an entirely new fund of knowledge is built up in less than fifteen minutes.

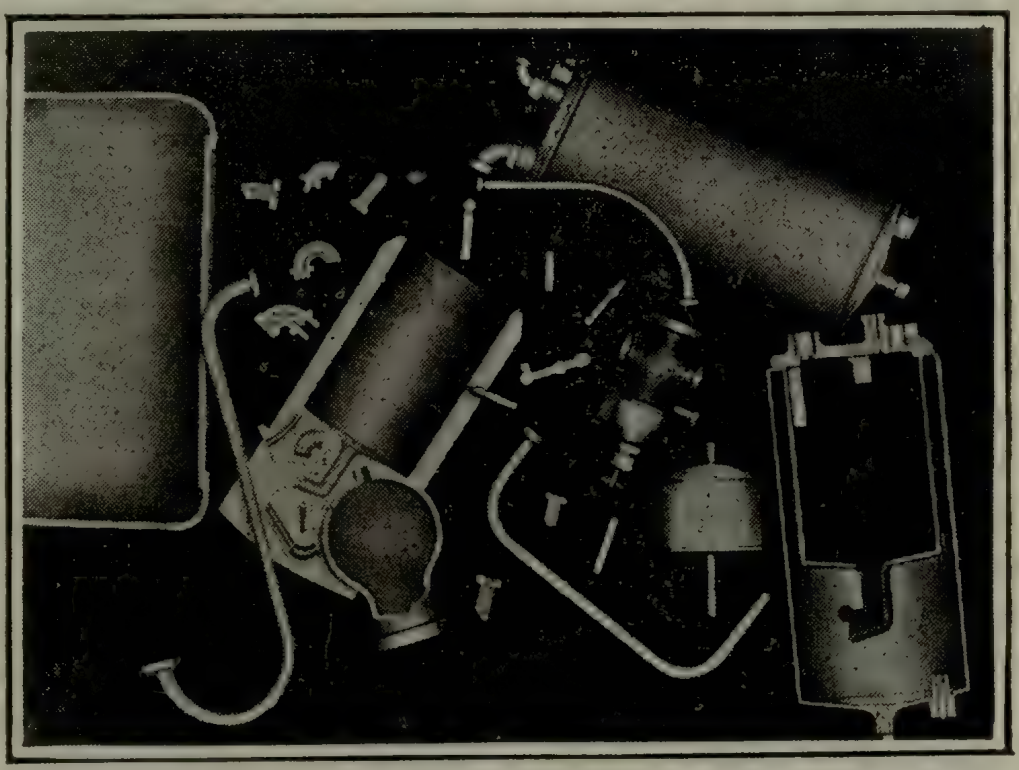
The Mechanigraphs and What They Mean

Let us explore a little in one corner of the vast field that will some day be completely covered through the agency of the motion picture. A manufacturer of automobiles, we will assume, desires to get before the public the complete story of his car. Or an institute of technology or some other educational institution desires to make the construction and operation of the automobile absolutely clear and understandable. It is desirable to save time in imparting knowledge and to create an impression that will be lasting and accurate and that will not be the result of tedious mental drudgery. How is it to be done?

A specialist in the making of mechanical motion pictures is consulted, the objects sought explained, the data supplied. The making of the picture is commenced.

It is a simple enough matter to make, in the usual way, moving pictures of all parts of the car that are visible. It is equally simple to dismantle the engine, or the gearset, or any other unit, then to photograph

the various parts and, in some cases, to show them in motion. But to make clear the actual action under working conditions is a different matter altogether. Take, for example, the familiar vacuum system for keeping the carburetter supplied with gasoline. All that is visible is a little tank and a few



Various parts of a Mechanigraph, prior to assembly. These parts are made of cardboard, carefully painted and retouched to produce good photographic effect. Note assembly on page 461.

pipes. Lay bare the working parts and they will not work. Some recourse must be had to a series of drawings, supplemented by verbal or printed explanations. In the last analysis the whole matter simmers down to the ability of the instructed to use their imagination and so mentally to visualize the apparatus. And it requires something more than an

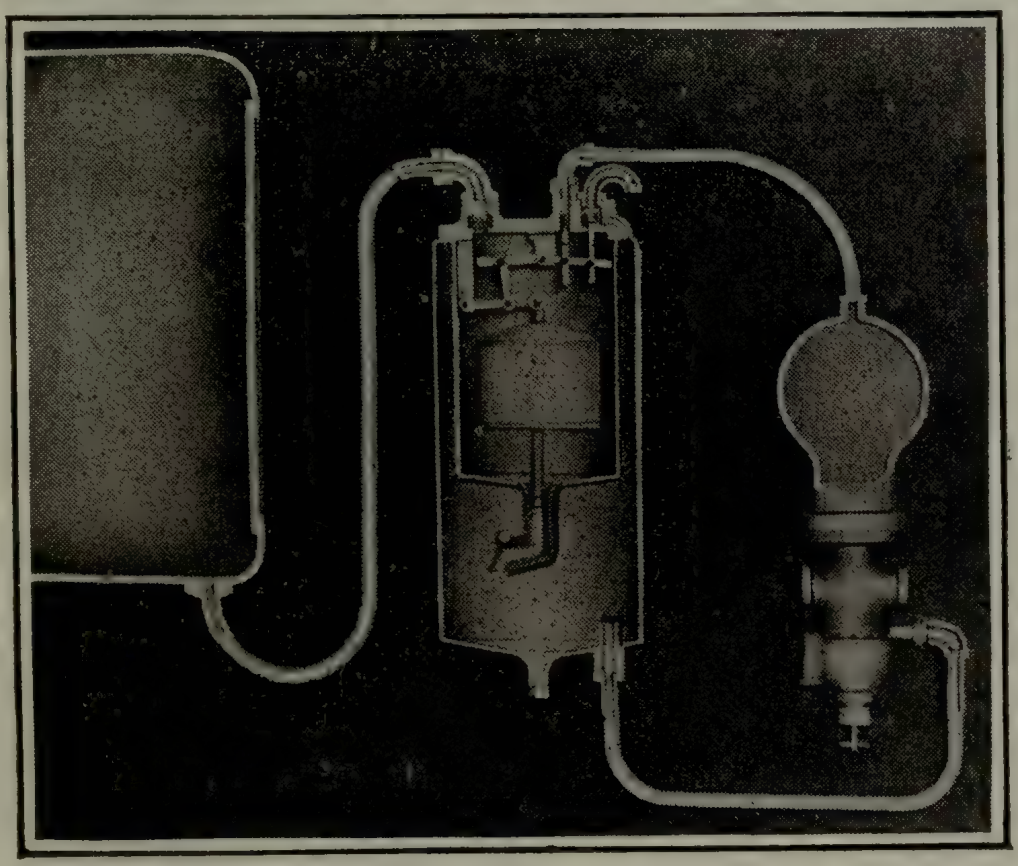
average imagination first to comprehend the analysis and then mentally to construct and finally mentally to operate the system.

Your motion picture engineer makes it his business to sweep away these difficulties, to eliminate the mental drudgery and to get at once to the heart of the subject—to show what the machine is for, what it consists of and how it works when the car is running. And, be it said, in doing this he takes upon his shoulders a task of no mean magnitude, which has a good deal to do with the fact that such interesting and truly invaluable pictures are not more common that they are.

At this stage of the proceeding another consideration enters. When the motion picture was in its early youth any picture that moved on the screen was acceptable. After the proverbial nine days, however, people became more discriminating; they demanded—and were given—pictures with an appeal beyond that of mere moving photography. Later there appeared the animated cartoon—the comic line drawing in which the characters and "props" moved in a more or less lifelike way. As a novelty, this was popular for a time, but the novelty soon wore off, and the animated cartoon is being supplemented by pictures that, while still designated as cartoons, have all the earmarks of being motion photographs of real things. They are produced by highly complex systems of double exposure, rephotographing photographs and so on. In fact, almost monthly some ingenious method of making animated cartoons or drawings finds its way to the Patent Office.

Showing the Public What Makes the Wheels Go Round

So it is with the instructive and educational mechanical picture. In its best-known form it has been chiefly an animated line drawing. While satis-



The Mechanigraph of a vacuum feed system of an automobile, the parts of which are shown on page 459, completely assembled, ready for filming. The various members of this Mechanigraph are animated during filming operations.

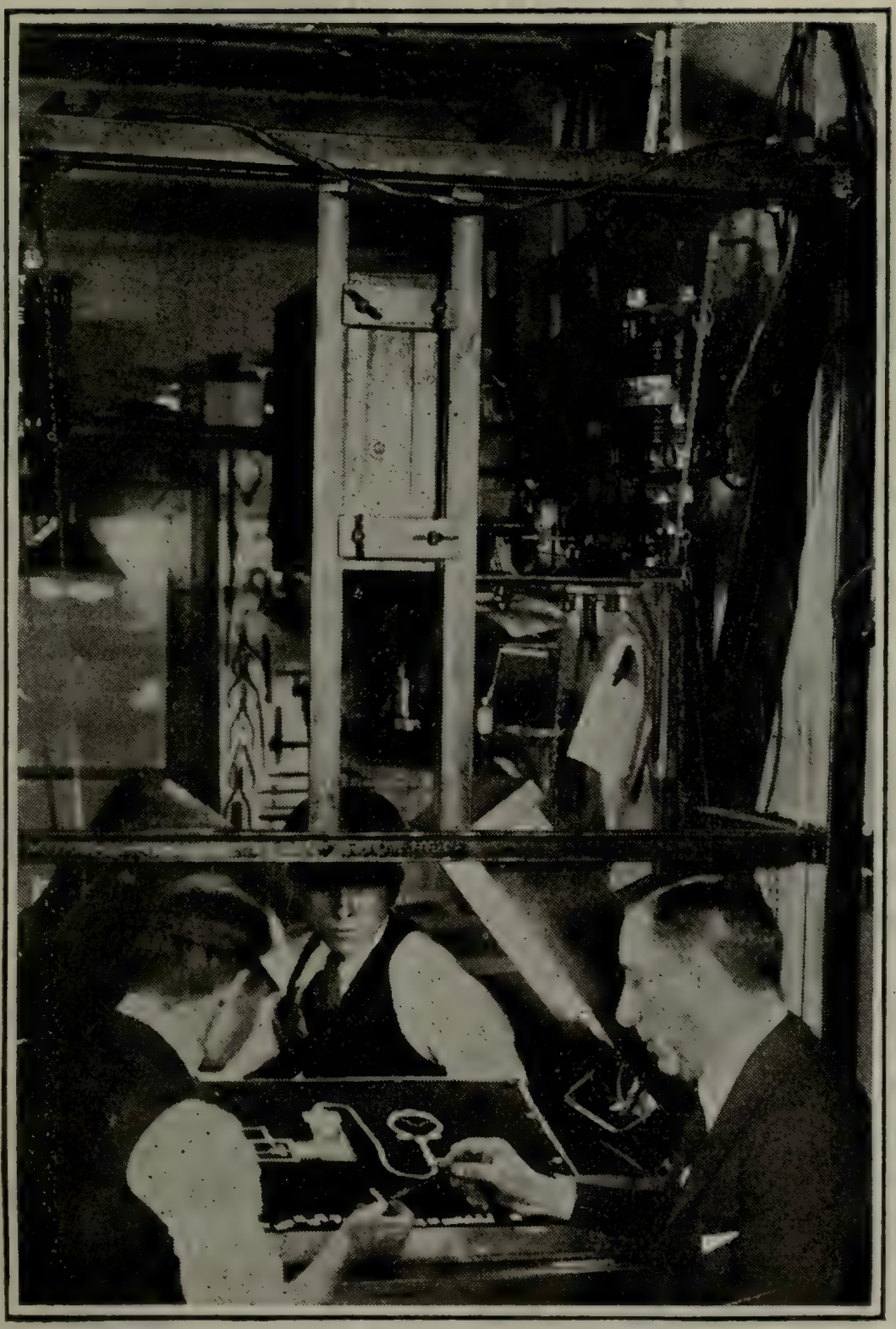
factory in some respects, such a picture is lacking in the very important element of reality. It is a representation of an idea, rather than a picture of the thing itself. Consequently, the present endeavor is to incorporate in the picture every possible ap-

pearance of actuality. And, to go back to the vacuum fuel-feed system, the end is accomplished as follows:

A drawing is made showing the system in cross-section, taken at a point that exposes all the working parts. Separate drawings are made of all the moving parts, all exactly to scale and of the correct form. All the parts are painted until they look quite real. Here a special knowledge of tone values is highly important. The tinting and shading that make an excellent half-tone cut, for instance, will often fall short of the appearance of reality when photographed under the motion-picture camera. For that reason, illustrations of the work are usually far less convincing in appearance than the images projected on the screen.

All the parts are assembled, joints and bearings being used so that they will move as they should. It is usual to make also toned drawings showing all exteriors, to show the external appearance of the apparatus at the beginning of the picture. These exteriors are "dissolved out" later, exposing the working parts.

Photographing the job involves special apparatus in the shape of an "animating stand." The animating stand, as we already know, consists, first, of a wooden or an angle-iron framework in the lower part of which is a broad table, at convenient working height, upon which the drawing—called a "mechanigraph" now that it is finished—is placed. The camera is carried overhead, with its lens pointing down toward the table, and is mounted on slides so



Animating camera stand employed in filming Mechanigraphs. Note the Mechanigraph of an automobile tire pump and tire, which is being filmed.

that it can be moved up or down to permit covering any size of field.

The motion picture camera has two shafts for operating its shutter and film-moving mechanism. When the shaft ordinarily used is rotated, each rotation causes eight exposures to be made. The second shaft causes one exposure to be made at each revolution and is known as the "stop-motion" shaft. This is the shaft used in making mechanigraphs. Instead, however, of being driven by hand through a crank, it is driven by a small electric motor. In photographing a job the motor is allowed to run continuously. It does not turn the shutter shaft, however, unless a trip is operated, by hand or by foot. When the trip is operated a positive clutch engages the shutter shaft, gives it one turn and makes one exposure, and then automatically disengages, the motor running idle until the trip is again operated. Needless to say the clutch is so adjusted that when idle the shutter is closed.

The mechanigraph is placed on the table and adjusted as to position so that it is in proper relation to the field of the lens, the camera's height is adjusted so that all or as much as may be desired of the drawing is in the field, the lens is focused, the stop or opening set, and the camera loaded with film and closed.

With everything finally ready for work the lights are turned on. These are mercury-vapor lamps suspended adjustably on each side of the table, so that the field is brilliantly and evenly illuminated by the greenish glow.

Using the Cross-Dissolve to Tie Different Drawings Together

In the case of the vacuum fuel-feed system, the picture is started by showing the exterior of the apparatus. There is no motion to be registered, so the trip is held in the operating position and the camera shaft is turned continuously until a sufficient length of film has been exposed. Then the exterior parts are "dissolved out." The most effective way of doing this is to use a "cross dissolve." By pressing a button on the camera a mechanism is engaged which gradually closes the shutter while the motor rotates the camera shaft. The result is that the light admitted through the lens is decreased slightly in each successive exposure until finally the shutter is completely closed and no light enters. If this film were developed the result would be a gradual fading of the picture until it would disappear completely.

At this point the drawings representing exteriors, which have been temporarily laid over the sectional drawings, are removed, bringing the working parts into view. Then with the shutter closed the film is run back to the exact point where the "fade" was commenced. The motor is then run forward and the fade is repeated, going over the same film as before—with one important difference. Where the shutter, on the "fade-out," began to close it now begins to open, and when the point is reached where the shutter was completely closed on the fade-out, it is wide open on the fade-in. This is called a "cross dissolve" or an "overlap dissolve." On the screen, the result

is that the exterior view dissolves—there is not a better word—into the interior.

A few feet of film are then run through showing the working parts stationary, after which the real work of the "animator" begins. The parts must be photographed in such a way as to show their movement. They cannot, however, be moved and photographed while they are moving, as in the familiar process of "straight" motion picture work. The parts are moved by hand a small fraction of an inch. Then the trip is operated and the motor causes the camera to make a single exposure. In motion picture parlance, one "frame" is exposed. Then the parts are moved another fraction of an inch and another exposure is made, and so on—a little movement and one exposure, another movement and another exposure, still another and another until the parts have completed a movement, or a series of movements. All movements must be equal when a steady motion is required; otherwise there will be a jump on the screen. In the case of the subject in question the movements were each about a thirty-second of an inch.

A curious feature of this work is that it is not really motion picture photography at all. It is simply a series of "still" photographs showing a succession of different positions of the object photographed. On the screen, however, the illusion of movement is perfect. Even if the animator, through an error of judgment, moves the parts too far at each exposure, the projected picture still maintains the illusion of motion rather than a succession of "stills," but the

motion will be a series of very rapid jerks or jumps.

The Problem of Combining Movements

One of the difficulties of mechanical animation becomes evident when there are several parts to be moved and it is impracticable so to connect them that they will move together. They must be moved separately, and the movements must be so gauged that the proper relative positions, will always exist. Usually this involves a schedule, prepared after all the movements have been exactly calculated and tabulated.

There is a good deal more to be done, however, before the work is finished. The object sought is not merely to show how the parts move, but rather to create a picture showing the effects caused by these movements as well. In the present instance this involves showing the flow of gasoline from the main tank to the vacuum tank, through the valves, from the upper to the lower tank and out to the carburetter. The principle used in creating the illusion of the rising or falling of liquid in a tank, or its flow through a pipe, is simple and can be applied in a number of ways. In the case of a tank, a piece of transparent celluloid is cut that will fit in the tank drawing, and provision is made for moving it up and down while showing only that portion which should properly be shown in the tank; the exact method will depend upon the nature of the job. On the celluloid lines are drawn, much as in drawing the conventional water of the drawing-board. When this is moved and photographed as described, the lines are "lost" on the screen and there is left the illusion of

movement of a transparent body. By using celluloid the tank can still be seen through the liquid, making the illusion so much more complete. Other equally simple tricks are employed to show the liquid falling in a broken stream and splashing foamily into the tank.

Part of the animator's stock in trade consists of unlimited patience. Such a picture as that of the vacuum fuel-feed will run about 400 feet. With sixteen frames per foot, this means a total of 6,400 frames. Some of these are run off rapidly under the camera, where there is no motion to be shown. There remain, however, about 5,000 frames that must be exposed individually, each after a careful setting of a number of parts. Small wonder, then, that the making of a film that will show on the screen for three or four minutes may involve anywhere from two days to two weeks of work under the animating camera—to say nothing of the time required for the preparation of the mechanigraphs by the draughtsmen and artists.

When a Few Drawings Make Gears Turn

There are cases where it is necessary to show movement that cannot be simulated by the methods already referred to. For instance, suppose it is desired to make a mechanigraph of a power-driven tire pump, such as is used in automobiles. In order to get the whole pump in section at the same time it is necessary to draw it in the plane of the crankshaft. This gives an edgewise view of the gears and crank; yet their motion must be shown. In the case of the

gears the "three-position" trick, well known to animators, is used. A drawing of the gear is made with the teeth carefully placed and spaced. Then a second is made precisely similar, but showing the teeth advanced through a distance equal to one-fourth of a tooth and a space, and a third shows a similar advance over the second. The first gear is laid in position and photographed—a single frame. Then the second, and then the third. Then the first is laid down again, and the second and third, and so on, for as many feet of film as may be necessary. If the drawing has been properly done the projected picture will show perfect motion. The person who is informed on the subject of motion pictures will recognize at once the connection between this procedure and the various illusions which are encountered in photographing the wheels of a moving vehicle.

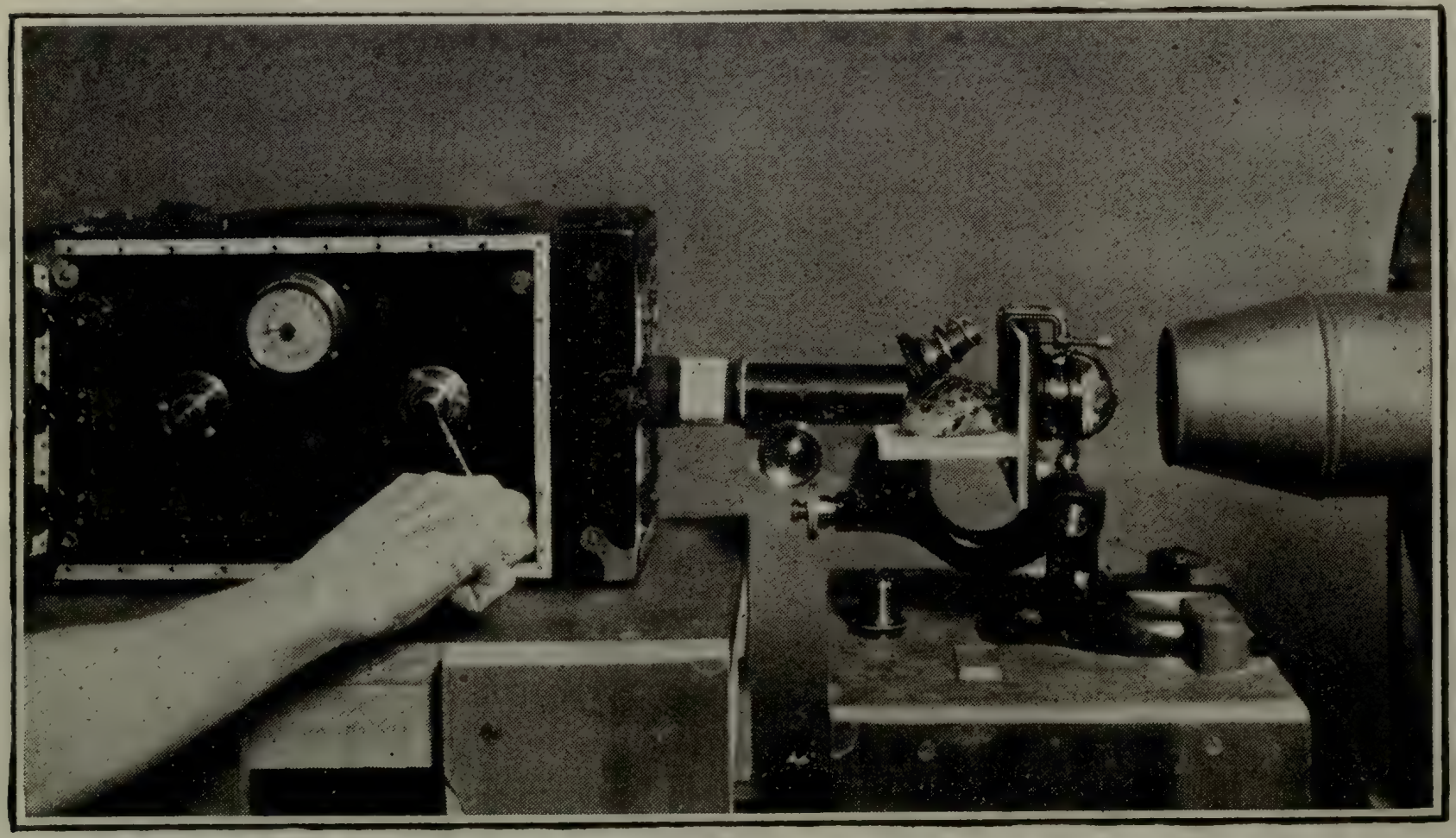
The crank has to be handled differently, for it changes its appearance as well as its apparent length with every move throughout its swing. A separate drawing is made for every position of the crank, and cut out. The cut-outs are laid down one at a time and photographed, the piston and connecting-rod positions being changed each time the crank is changed. When the connecting rod moves back—that is, away from the spectator—it naturally goes into the shadow of the cylinder and crank-case. So a separate piece, precisely like the connecting rod but darker, is laid on when the rod is in the shadow. This gives the impression that the rod swings back and forth, when in reality it simply moves straight

up and down in its operation before the camera.

There are innumerable other tricks and devices that are called into play by the mechanical animator, and many pieces of special apparatus are devised to attain specific results. Many of these ideas are more or less jealously guarded as "trade secrets," but the truth is that once a picture is shown on the screen, a good animator can figure out pretty accurately how it was made, and can generally do the same thing himself. There are few set rules and processes in the type of mechanical animation described. Every job brings its own individual problems, and solving them ever involves new schemes and tricks—it is just one little invention after another. But this very fact makes the work more than fascinating in spite of its difficulties, and the greatest reward an animator can ask is a perfect picture on the screen. That brings with it a thrill that is even beyond that of the author who sees his work in type for the first time.

Filming the Invisible With the Microscope and Motion Picture Camera

The resourceful cameraman can secure many an interesting subject with the aid of the microscope. The elements of microscopic motion picture photography are a camera, microscope of the desired power, a condenser, and a powerful source of light. Generally an arc light is necessary, in order to secure sufficient light for the instantaneous exposures. The usual lens is removed from the camera, the reflecting mirror is removed from the microscope, and the



Making a motion picture of the circulation of blood in a frog's leg. The standard microscope is employed for this purpose, the eye-piece being removed. A powerful source of light must be used, such as an arc lamp.

microscope is connected up with the camera in the manner shown in the accompanying illustration. A short length of rubber hose serves to make a good light-tight connection between microscope and camera, the usual camera lens being removed. The microscope, in other words, furnishes the lens.

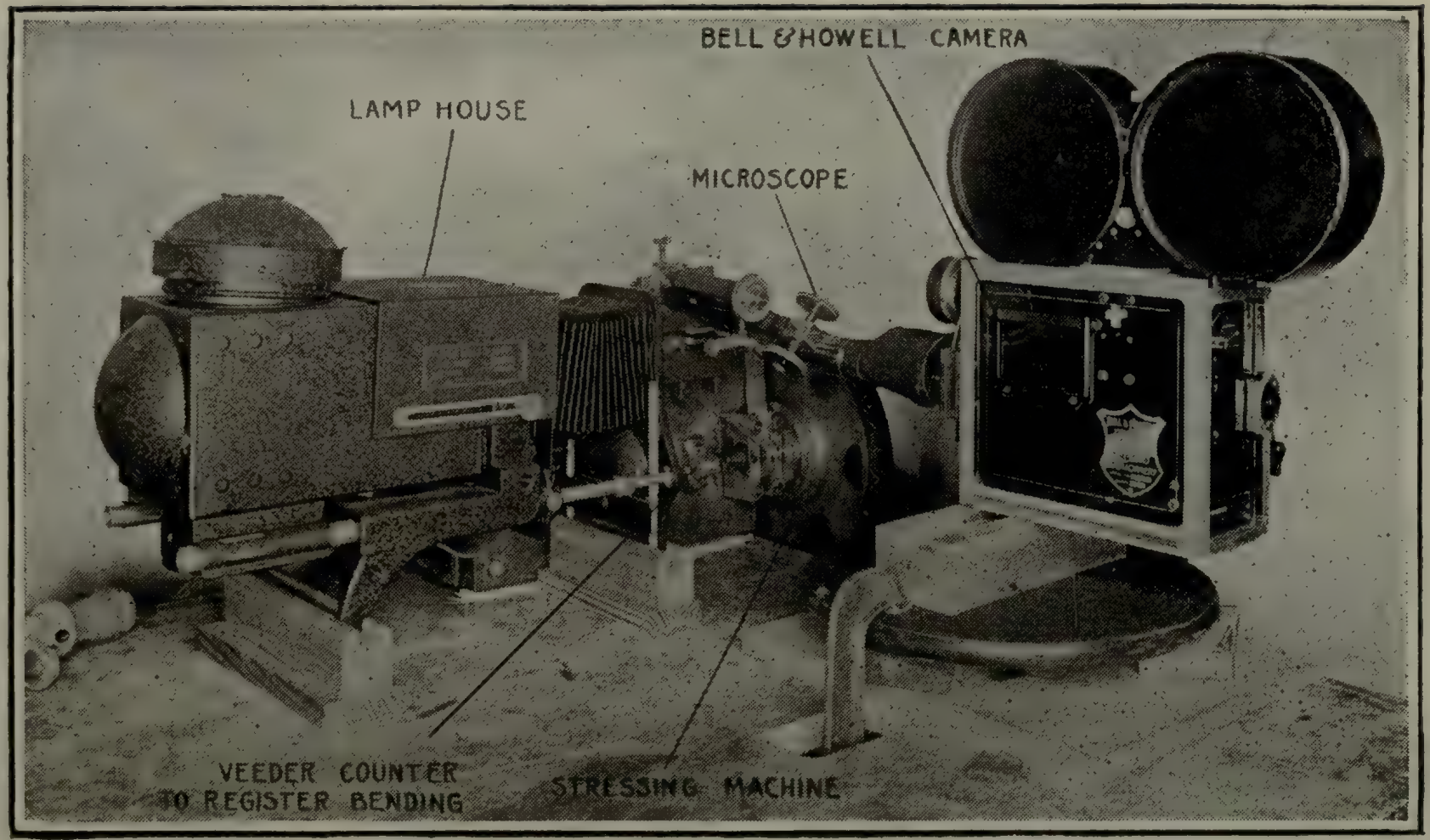
One or two points must be observed to ensure success. First of all, however simple the camera or microscope employed, it is essential to have both firmly supported in some manner so as to avoid movement of the apparatus during focusing or when operating the camera. It is true that passable results may be obtained with nothing more elaborate than the microscope placed on a table with the tube horizontally led to the motion picture camera mounted on its tripod or resting on the same support as the other apparatus. However, it is far better to have the microscope clamped in position on a long, stout board, and to mount the camera, by means of a heavy screw passing up through a long slot in the board and screwing into the camera screwhole, to the same board. Thus there is no danger of moving the camera or microscope out of alignment while cranking or making the necessary adjustments.

The lamp house with arc lamp taken from an obsolete motion picture projector makes an excellent illuminant. The usual incandescent lamp is useless for anything but very low power work, and even then must always have ground glass interposed, or even lighting will be out of the question. The arc lamp is unquestionably the best illuminant, since we are dealing with instantaneous photography, which requires

a powerful illumination, as we must realize by now.

If the apparatus is set up on a board, all clamped in place, the first step is to place the specimen to be photographed on the glass slide, and to turn on a light. The arc is unnecessary for the preliminaries. With a one-inch objective and low power eyepiece in position, the operator can focus as usual by looking through the microscope. This may be done quite roughly as at this point we merely want to get the object in the field of view. Unless our instrument is a very old pattern, it will almost certainly possess some form of condenser under its stage with or without means of focusing, and have an iris diaphragm. The top lens of this condenser should be removed when using the one-inch or lower powers and replaced for the ½-inch or higher ones. The iris is opened out and then the camera is moved up as the microscope, held at a convenient distance all this while, is swung down to the horizontal position, so that the eyepiece of the microscope projects into the place usually occupied by the camera lens. All stray light at the junction of the two instruments can be stopped by some loose covering, such as a length of rubber tubing, a piece of heavy velvet, or a sheet of focusing cloth. Looking now through the peephole of the camera, it is possible, after considerable manœuvering and focusing of the miscroscope, to see the image on the film or focusing ground glass. The lighting must be jockeyed along until the illumination noted in the focusing is more or less even.

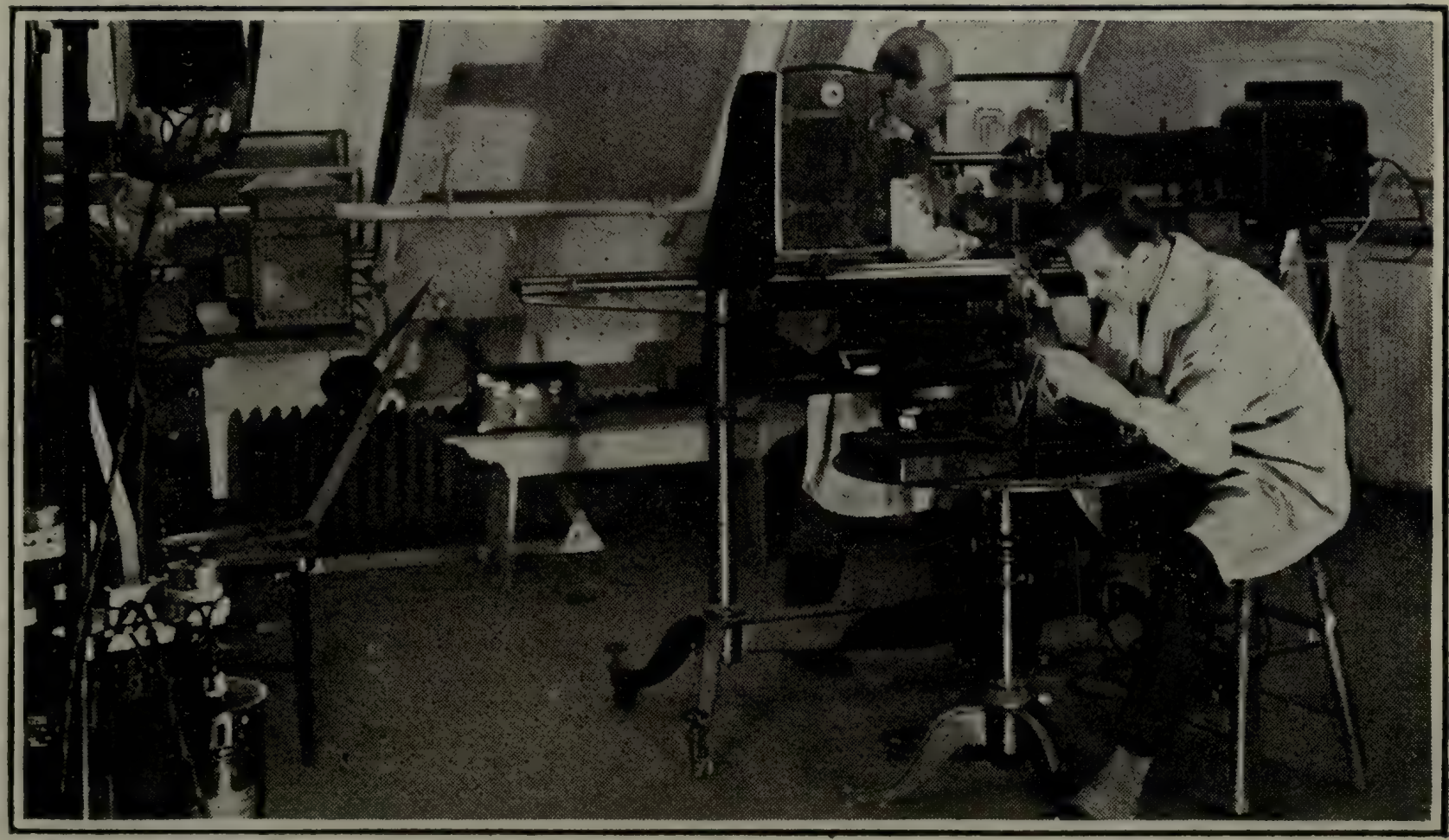
Now, nearly all miscroscopic outfits include a simple stand condenser, called a "bull's-eye" condenser,



This assembly of equipment was employed to film the breaking down of a piece of iron under constant stress. A bending machine stressed the iron, while a motion picture camera recorded the action of the specimen. A Veeder counter kept track of the extent of the stressing.

and by placing this close to the light it is possible to obtain, when it is in the proper position, a parallel beam of light covering the back of the substage condenser. The path of the beam will be clearly seen if tobacco smoke is blown across it. If an iris diaphragm can be fitted to the bull's-eye, or placed just in front of it, it will be a useful help, or failing this, a few pieces of card faced with circular holes from ⅛ inch to 2 inches in diameter will be of service. Assuming that we have such an iris, this must be closed down to a small opening and then by moving the substage condenser to and fro we shall get an image of this small opening on the focusing screen. Having this image central and as sharp as possible (the focusing being done by moving the substage condenser), we gradually open it out till it just encloses the image we want to photograph, after which we close down the substage iris till we get the best possible definition and finally focus as accurately as possible with the microscope. If a light filter is being used, this must be placed between the bull's-eye and the microscope before the final focusing.

The use of a light filter, or color screen as it is called, is always advisable, since the definition of ordinary objectives is always improved if a yellow or yellow-green filter is used. It should be understood that in photomicrography such filters may be used as in ordinary work for the purpose of getting correct tone values, but their chief use (in addition to improving definition) will be to increase either contrast or detail. By using various color filters any particular color can be emphasized or subdued. For



Corner of a naturalist's laboratory where motion pictures of microscopic subjects are produced. Note the special stand on which the camera, microscope and arc lamp are placed. The man at the right is preparing a microscopic slide.

general use a green filter, such as that used in three-color process engraving, will be found the best all-round filter for photomicrography. The following table is only a rough guide to the selection of the most suitable filter to use when photographing colored preparations and contrasty results are required. It must be remembered that the usual film, which is not sensitive to red and orange, must be replaced by panchromatic stock when using certain color filters.

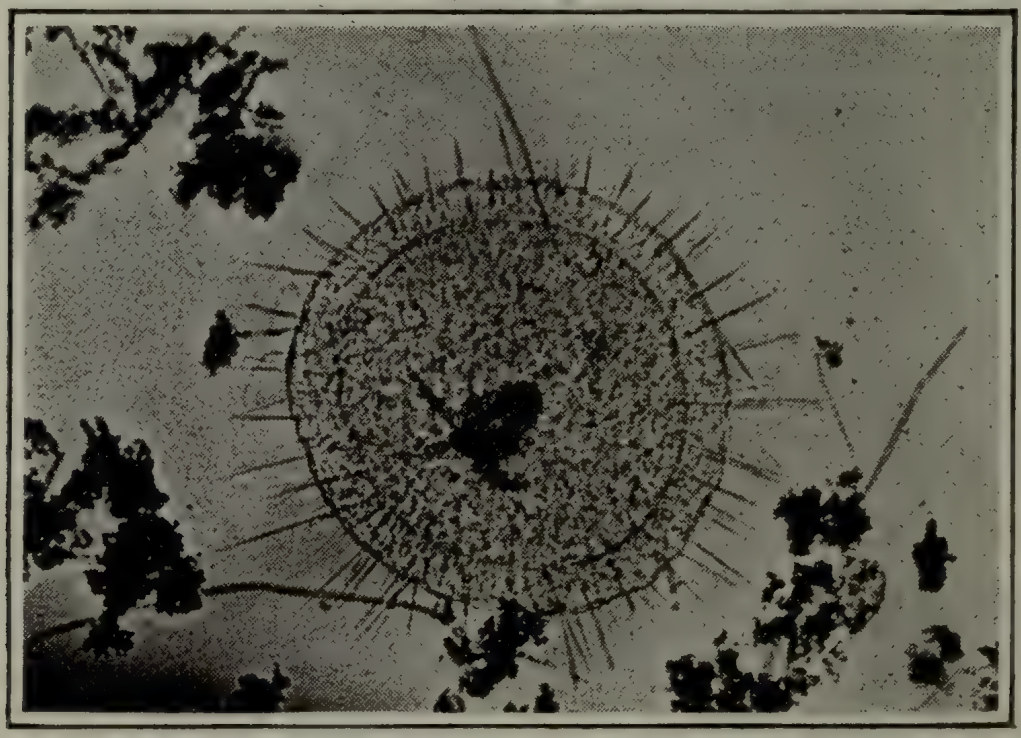
With	a	blue	stained	preparation	use	a	red filter.
"	"	green	"	"	"	"	red "
"	"	red	"	"	"	"	green "
"	"	yellow	"	"	"	"	blue "
"	"	brown	"	"	"	"	blue "
"	"	purple	"	"	"	"	green "
"	"	violet	"	"	"	"	yel'w "

There are many things to learn regarding microphotography in motion picture form, and the amateur will find this an interesting field for the exercise of ingenuity. Many of the specimens which he attempts to film may not be able to withstand the intense heat of the arc lamp, with the result that he may have to improvise certain liquid condensers and ray filters intended not only to eliminate undesirable color rays from the light, but also to absorb some of the heat. Then again, he may have to devise some form of shutter which works synchronously with the motion picture camera shutter, in order that the specimens may only be subjected to the heat of the light at such times as the camera shutter is opened.

At any rate, this is a worthwhile field to try, and there is always a good demand for good films of this class.

Reducing Months to Minutes on the Screen

One of the most interesting effects that is ever produced on the screen is the speeding up of plant growth,



Typical microscopic scene, showing how one of the lower forms of life ensnares its prey.

building operations and other things. That is to say, what normally requires say two or three months, is shown on the screen in the short span of five to ten minutes. Here again the trick is turned by the stop-motion or single-picture movement of the average motion picture camera. It is a matter of exposing one frame at a time, in this case at long intervals, say half an hour or an hour or more with some subjects, and when such a film is run off in the projector

at the rate of sixteen images per second, it stands to reason that eight hours or sixteen hours of development may be shown in one second.

A most ingenious apparatus for automatically making motion pictures showing the growth and development of plants, insects and micro-organisms, has recently been perfected by E. S. Rinaldy of New York City, who has applied for a patent on same.

The Rinaldy apparatus not only eliminates the human equation of error in making a series of exposures at properly spaced intervals, but does away with the necessity of constant supervision by expert cameramen while the period of picture making is under way. The apparatus consists of a universally adjustable stand, accommodating the camera, the subject, and one or more lights, and is so adjusted that the camera may be manipulated, the object focused, and the lighting system arranged to the best advantage. The stand permits of making the picture by sunlight if this is desired, and both the subject and the camera may be held in proper position with regard to the position of the sun at the time of exposure.

The operating mechanism of the Rinaldy apparatus consists of a fourteen-day time clock, supplied with a set of interchangeable timing disks which permit of exposures being made at intervals of from one second to twelve hours, as may be desired; and these disks, which may be interchanged without loss of time, permit of the variation of time between the exposures of the film with the varying rate of development or progress of the subject at different stages of plant or organic life, as the case may be.

The time clock, at predetermined intervals, opens and closes a switch, furnishing current to a motor that actuates the mechanism which switches on the current for the lighting equipment, exposes the film, and then switches off the lights. The lights are switched on a quarter of a second before the exposure of the film and are extinguished one-quarter to a second after exposure. By reducing the artificial light to a minimum of time beyond that actually required for the exposure, the injurious effects of light upon many forms of micro-organisms are obviated to the greatest possible degree.

The Rinaldy apparatus may be used for the scientific recording in motion pictures of the growth of a flower, the opening and shutting of a flower, and its method of following the sun in its course, the growth of insect life from the egg to the perfected image or the cultivation of bacteria as viewed through the microscope, in which latter case the camera is utilized in connection with microscopic apparatus.

Pictures Shot from the Air

A fruitful field for the cinematographer is the air —that is to say, filming from the air. Aerial pictures are in great demand, not only for entertainment and educational purposes, but for advertising and selling purposes. The manufacturer can present a better idea of the magnitude and arrangement of his plant by means of an aerial view than in any other manner; and the real estate promoter, developing a new tract of land, can tell more about the location, layout, geographical and topographical features of his land by

means of an aerial film than in any other conceivable way.

Of course, this means an airplane, for there is no

Motion picture camera equipped with an electric motor so as to eliminate hand cranking. This camera is especially intended for aerial photography.

other satisfactory way of making aerial views. Throughout the United States there are intrepid young aviators who are ready to rent their machines by the minute, hour or day for the purpose of making pictures. The usual charge is a dollar per minute in the big cities, but even though this charge seems exorbitant, one must remember the footage that can be ground out in that time.

While the usual camera serves very nicely for aerial filming operations, there have of late appeared special cameras for this kind of work. A New Yorker, Frank T. Morris, has lately developed a motor-driven camera which is proving quite popular for this kind of cinematography. His camera is driven by an eighth-horsepower electric motor which takes its current from a storage battery. The camera is also provided with a pair of stout handles, and by means of these the cameraman can aim the camera in any desired direction and press a button to start the filming, there being no hand cranking to bother with. By dispensing with the usual tripod, wonderful freedom of action is obtained. In this connection a pneumatic breast cushion worn by the cameraman and against which the camera is pressed for better support, serves to absorb all vibration from the airplane motor.

The camera can be adapted to all sorts of trick pictures, because of the ease with which it may be swung about. It can be used for filming fast moving objects, such as football players, baseball players, horse and automobile racing, racing boats, etc. The total weight of the camera complete is 21 pounds. It carries 400 feet of film. The storage battery which

drives the motor has a capacity of ten consecutive hours, or sufficient driving power to crank 30,000 feet of film.

Motion Analysis

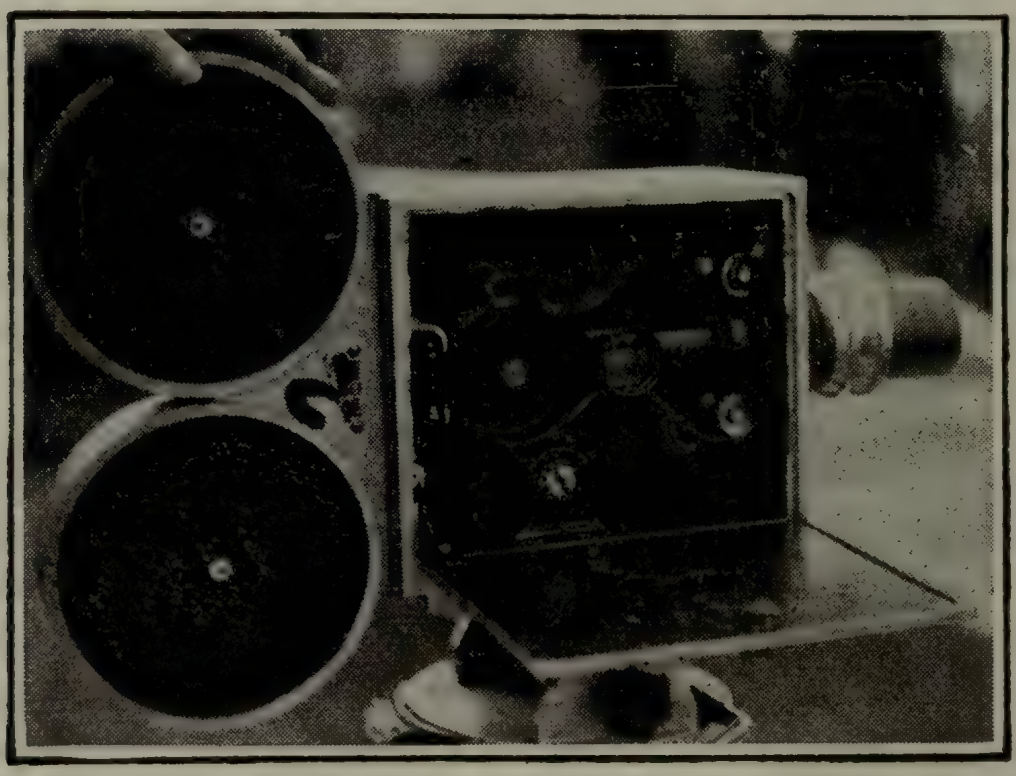
Most unusual effects can be obtained by taking pictures at a high rate of speed and projecting them at the standard speed. Such pictures show tennis balls and hurdling horses floating through the air, boxers gently and nonchalantly fanning and tapping each other, and so on. There are various special cameras for this kind of work—high speed filming.

A new speed camera for motion picture work, designed to overcome the objectionable features of the makeshift devices heretofore used for this work, has been invented by a Pacific Coast man. The chief characteristic of the new camera is a straight pull on the film. With a camera capable of taking 14 feet of film (224 separate pictures) per second, it will be readily appreciated that there is a terrific strain on the film, to say nothing of similar destructive influence on the camera itself.

With the film magazines mounted at the back, the new camera takes the film in a direct line to the aperture and in another direct line back to the take-up magazine, thus providing an instrument that has only one turn for the film.

With a turning mechanism that is geared very high, each turn of the handle exposes seven feet of film. The handle is turned at the same rate as on an ordinary camera—two turns a second—hence to the operator there is no difference in manipulation.

Of course, when such a film is projected at the ordinary rate of speed, objects move very slowly, one step of a runner, for instance, taking ten seconds or more



One of the various models of ultra-rapid camera. Each turn of the handle exposes seven feet of film instead of the usual half foot.

on the screen. This makes the instrument of incalculable value in scientific work, as well as providing an inexhaustible field for makers of screen magazine pictures.

Chapter XV.

MISCELLANEOUS DATA AND FORMULÆ

Fire Regulations Regarding Handling of Inflammable Film

Most municipalities have ordinances applying to the handling and storage of film. It is well for the person handling considerable quantities of inflammable film to inquire of the proper authorities just what the restrictions are, in order to avoid complications should some unfortunate accident take place. So the author has taken the liberty of presenting the following Article 20 from Chapter 10 of the Code of Ordinances of the City of New York, relating to the handling and storage of inflammable motion picture films. This information is published in full in a booklet that is obtainable from the Bureau of Fire Prevention, Fire Department, Municipal Building, New York City. Other cities have very similar regulations, so that these rules may be considered as quite typical:

ARTICLE 20

Inflammable Motion Picture Films

Section 240. Permit.
241. Restrictions.
242. Storage-rooms.
243. Work-rooms.

244. Fire prevention.
245. Projecting machines.
246. Transportation.

§240. PERMIT.

No person shall store or keep on hand any inflammable motion picture films in quantities greater than 5 reels, or aggregating more than 5,000 feet in length, without a permit.

§241. RESTRICTIONS.

No permit for the storage of inflammable motion picture films shall be issued for any building—

(*a*) Which is situated within 50 feet of the nearest wall of any building occupied as a school, theatre, or other place of public amusement or assembly;

(*b*) Which is occupied as a tenement house, dwelling or hotel;

(*c*) Which is artificially lighted by any means other than electricity;

(*d*) Which is of wooden construction;

(*e*) Which is not equipped with an approved system of automatic sprinklers;

(*f*) Which does not contain one or more separate rooms used exclusively for the storage of such films.

§242. STORAGE ROOMS.

A room, vault or compartment used for the storage of inflammable motion picture films shall not be artificially lighted except by electric lights having

air tight bulbs, globes or tubes encased in suitable wire cages and fitted with keyless sockets.

§243. Work Rooms.

1. *Construction and fittings.* All examining, repairing or piecing together of inflammable motion picture films shall be done in a room used for no other purpose and separated from the rest of the building by fire-proof partitions and self-closing fire-proof doors. All furniture and fittings in a room where inflammable motion picture films are repaired or pieced together shall be of metal or other fire-proof material.

2. *Quantity of film permitted.* Not more than 10 reels, nor more than 10,000 feet in the aggregate of motion picture films, shall be under examination or repair at one time; and each reel of films shall be kept in a tightly closed metal box when not being examined or repaired.

3. *Receptacles for waste.* Each room used for the repairing or piecing together of inflammable motion picture films shall contain a metal can, wherein all waste parts and scraps of such films shall be placed and kept covered with water.

4. *Supervision.* All storage, manufacturing, repairing and examination of inflammable motion picture films shall be under the direct supervision of one or more persons holding a certificate of fitness from the Fire Commissioner; such persons shall be charged with the enforcement of Section 8 of this chapter prohibiting smoking.

§244. Fire Prevention.

1. *Storage of cements.* No collodion, amyl acetate or other similar inflammable cement or liquid in quantities greater than 1 quart shall be kept in a room where inflammable motion picture films are stored or repaired. Premises wherein inflammable motion picture films are stored, manufactured, repaired or examined shall be equipped with a number of sand and water buckets and fire extinguishers satisfactory to the Fire Commissioner.

2. *Heating appliances.* No heat other than steam or hot water, and no stove, forge, torch, boiler, furnace, flame or fire, and no electric or other appliance likely to produce an exposed spark shall be allowed in any room used for the storage or repair of inflammable motion picture films.

§245. Projecting Machines.

No inflammable motion picture film shall be used in any moving picture projecting machine not enclosed in an approved booth.

§246. Transportation.

No person shall transport inflammable motion picture films in any underground subway train, or carry the same into any underground subway station, provided, however, that the provisions of this paragraph shall not apply to inflammable films transported in the course of interstate commerce in railway baggage or express cars under the jurisdiction and subject to the regulations of the Interstate Commerce Commission. No person shall transport

inflammable motion picture films in any street car, elevated train, omnibus, ferryboat or other public conveyance, or carry the same into any railway station or ferryhouse unless each film shall be separately enclosed in a tightly closed metal box. Not more than 8 films so enclosed shall be carried at one time by any person.

ARTICLE 26

Miscellaneous

§300. VIOLATIONS.

Any person who shall wilfully violate or neglect or refuse to comply with any provisions of this chapter, in addition to any other penalties prescribed by law or ordinance, shall, upon conviction, be punished by a fine of not more than $500 or by imprisonment not exceeding 6 months, or by both such fine and imprisonment.

THERMOMETER SCALES

Reaumer divides the space between the freezing and boiling points into 80 degrees. France uses that of Celsius, who graduated his scale on the decimal system. The most peculiar scale of all, however, is that of Fahrenheit, a renowned German physicist, who, in 1714 or 1715, composed his scale, having ascertained that water can be cooled under the freezing point, without congealing. He therefore did not take the congealing point of water, but composed a

mixture of equal parts of snow and sal ammoniac, about —14 deg. R. To change a temperature as given by Fahrenheit's scale into the same as given by the centigrade scale, subtract 32 degrees from Fahrenheit's degrees, and multiply the remainder by 5-9. The product will be the temperature in centigrade degrees.

To change from Fahrenheit's to Reaumer's scale, subtract 32 degrees from Fahrenheit's degrees and multiply the remainder by 4-9. The product will be the temperature in Reaumer's degrees.

C = Centigrade. R = Reaumer. F = Fahrenheit.

C.	R.	F.	C.	R.	F.
—30	—24.0	—22.0	—7	—5.6	19.4
—29	—23.2	—20.2	—6	—4.8	21.2
—28	—22.4	—18.4	—5	—4.0	23.0
—27	—21.6	—16.6	—4	—3.2	24.8
—26	—20.8	—14.8	—3	—2.4	26.6
—25	—20.0	—13.0	—2	—1.6	28.4
—24	—19.2	—11.2	—1	—0.8	30.2
—23	—18.4	—9.4	0	0.0	32.0
—22	—17.6	—7.6	1	0.8	33.8
—21	—16.8	—5.8	2	1.6	35.6
—20	—16.0	—4.0	3	2.4	37.4
—19	—15.2	—2.2	4	3.2	39.2
—18	—14.4	—0.4	5	4.0	41.0
—17	—13.6	1.4	6	4.8	42.8
—16	—12.8	3.2	7	5.6	44.6
—15	—12.0	5.0	8	6.4	46.4
—14	—11.2	6.8	9	7.2	48.2
—13	—10.4	8.6	10	8.0	50.0
—12	—9.6	10.4	11	8.8	51.8
—11	—8.8	12.2	12	9.6	53.6
—10	—8.0	14.0	13	10.4	55.4
—9	—7.2	15.8	14	11.2	57.2
—8	—6.4	17.6	15	12.0	59.0

C.	R.	F.	C.	R.	F.
16	12.8	60.8	59	47.2	138.2
17	13.6	62.6	60	48.0	140.0
18	14.4	64.4	61	48.8	141.8
19	15.2	66.2	62	49.6	143.6
20	16.0	68.0	63	50.4	145.4
21	16.8	69.8	64	51.2	147.2
22	17.6	71.6	65	52.0	149.0
23	18.4	73.4	66	52.8	150.8
24	19.2	75.2	67	53.6	152.6
25	20.0	77.0	68	54.4	154.4
26	20.8	78.8	69	55.2	156.2
27	21.6	80.6	70	56.0	158.0
28	22.4	82.4	71	56.8	159.8
29	23.2	84.2	72	57.6	161.6
30	24.0	86.0	73	58.4	163.4
31	24.8	87.8	74	59.2	165.2
32	25.6	89.6	75	60.0	167.0
33	26.4	91.4	76	60.8	168.8
34	27.2	93.2	77	61.6	170.6
36	28.8	96.8	78	62.4	172.4
37	29.6	98.6	79	63.2	174.2
38	30.4	100.4	80	64.0	176.0
39	31.2	102.2	81	64.8	177.8
40	32.0	104.0	82	65.6	179.6
41	32.8	105.8	83	66.4	181.4
42	33.6	107.6	84	67.2	183.2
43	34.4	109.4	85	68.0	185.0
44	35.2	111.2	86	68.8	186.8
45	36.0	113.0	87	69.6	188.6
46	36.8	114.8	88	70.4	190.4
47	37.6	116.6	89	71.2	192.2
48	38.4	118.4	90	72.0	194.0
49	39.2	120.2	91	72.8	195.8
50	40.0	122.0	92	73.6	197.6
51	40.8	123.8	93	74.4	199.4
52	41.6	125.6	94	75.2	201.2
53	42.4	127.4	95	76.0	203.0
54	43.2	129.2	96	76.8	204.8
55	44.0	131.5	97	77.6	206.6
56	44.8	132.8	98	78.4	208.4
57	45.6	134.6	99	79.2	210.2
58	46.4	136.4	100	80.0	212.0

OUR THREE SYSTEMS OF WEIGHT

Apothecaries' Weight is the official standard of the United States Pharmacopoeia. In buying and selling medicines not ordered by prescriptions avoirdupois weight is used.

Lb.		Oz.		Dr.		Scr.		Gr.
1	=	12	=	96	=	288	=	5760
		1	=	8	=	24	=	480
				1	=	3	=	60
						1	=	20

Avoirdupois Weight.—Used for weighing all goods except those for which troy and apothecaries' weight are employed.

Gross or Long

Ton.		Cwt.		Qr.		Lb.		Oz.		Dr.
1	=	20	=	80	=	2,240	=	35,840	=	573,440
		1	=	4	=	112	=	1,792	=	28,672
				1	=	28	=	448	=	7,168
						1	=	16	=	256
								1	=	16

Short or Net

Ton.		Cwt.		Qr.		Lb.		Oz.		Dr.
1	=	20	=	80	=	2,000	=	32,000	=	512,000
		1	=	4	=	100	=	1,600	=	25,600
				1	=	25	=	400	=	6,400
						1	=	16	=	256
								1	=	16

The "short" ton of 2,000 lbs. is used commonly in the United States. The British or "long" ton, used to some extent in the United States, contains 2,240 lbs., corresponding to a cwt. of 112 and a quarter of 28 lbs.

Troy Weight.—Used by jewelers and at the mints, in the exchange of the precious metals.

Lb.		Oz.		Dwt.		Gr.
1	=	12	=	240	=	5760
		1	=	20	=	480
				1	=	24

7000 troy grains	=	1 lb. avoirdupois.
175 troy pounds	=	144 lb. avoirdupois.
175 troy ounces	=	192 oz. avoirdupois.
437½ troy grains	=	1 oz. avoirdupois.
1 troy pound	=	.8228 + lb. avoirdupois

The common standard of weight by which the relative values of these systems are compared is the grain, which for this purpose may be regarded as the unit of weight. The pound troy and that of apothecaries' weight have each five thousand seven hundred and sixty grains; the pound avoirdupois has seven thousand grains.

The relative proportions and values of these several systems are as follows:

Troy.	Avoirdupois. Oz.	Dr.
1 pound equals	13	2.65
1 ounce equals	1	1.55
1 dwt. equals	0	0.877

Troy.	Apothecaries' Lb.	Oz.	Dr.	Scr.	Gr.
1 pound equals	1	0	0	0	0
1 ounce equals	0	1	0	0	0
1 dwt. equals	0	0	0	1	4
1 grain equals	0	0	0	0	1

Apothecaries'.	Avoirdupois. Oz.	Dr.
1 pound equals	13	2.65
1 ounce equals	1	1.55
1 drachm equals	0	2.19
1 scruple equals	0	0.73

Apothecaries'.	Troy Lb.	Oz.	Dwt.	Gr.
1 pound equals	1	0	0	0
1 ounce equals	0	1	0	0
1 drachm equals	0	0	2	12
1 scruple equals	0	0	0	20

Avoirdupois.	Troy Lb.	Oz.	Dwt.	Gr.
1 long ton equals	2722	2	13	8
1 cwt. equals	136	1	6	16
1 quarter equals	34	0	6	16
1 pound equals	1	2	11	16
1 ounce equals		0	18	5½
1 drachm equals		0	1	3 11/32

Avoirdupois.	Troy Lb.	Oz.	Dwt.	Gr.
1 short ton equals	2430	6	13	8
1 cwt. equals	121	6	6	16
1 quarter equals	30	4	11	16

Avoirdupois.	Apothecaries' Lb.	Oz.	Dr.	Scr.	Gr.
1 pound equals	1	2	4	2	0
1 ounce equals	0	0	7	0	17½
1 drachm equals	0	0	0	1	7 11/32

Troy Weight

12 ounces = 1 pound
20 pwts. = 1 ounce
24 grains = 1 pwt.

Used for weighing gold, silver and jewels.

Apothecaries' Weight

20 grains = 1 scruple
3 scruples = 1 dram
8 drams = 1 ounce
12 ounces = 1 pound

The ounce and pound in this are the same as in Troy weight.

Avoirdupois Weight

27 11-32 grains = 1 dram
16 drams = 1 ounce
16 ounces = 1 pound
25 pounds = 1 quarter
4 quarters = 1 cwt.
2,000 lbs. = 1 short ton
2,240 lbs. = 1 long ton

Dry Measure

2 pints = 1 quart
8 quarts = 1 peck
4 pecks = 1 bushel
36 bushels = 1 chaldron

Liquid Measure

4 gills = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
31½ gallons = 1 barrel
2 barrels = 1 hogshead
16 fluid ounces = 1 pint

Time Measure

60 seconds = 1 minute
60 minutes = 1 hour
24 hours = 1 day
7 days = 1 week
28, 29, 30 or 31 days = 1 calendar month (30 days = 1 month in computing interest.)
365 days = 1 year
366 days = 1 leap year

Long Measure

12 inches = 1 foot
3 feet = 1 yard
5½ yards = 1 rod
40 rods = 1 furlong
8 furlongs = 1 sta. mile
3 miles = 1 league

Cloth Measure

2¼ inches = 1 nail
4 nails = 1 quarter
4 quarters = 1 yard

Square Measure

144 sq. inches = 1 sq. ft.
9 sq. ft. = 1 sq. yard
30¼ sq. yards = 1 sq. rod
40 sq. rods = 1 rood
4 roods = 1 acre
640 acres = 1 sq. mile

Surveyors' Measure

7.92 inches = 1 link
25 links = 1 rod
4 rods = 1 chain
10 sq. chains or 160 sq. rods = 1 acre
640 acres = 1 sq. mile
36 sq. miles (6 miles square) = 1 township

Cubic Measure

1,728 cubic in. = 1 cubic ft
128 cu. ft. = 1 cord (wood)
27 cu. ft. = 1 cubic yd.
40 cu. ft. = 1 ton (shpg.)
2,150.42 cubic inches = 1 standard bushel
231 cubic inches = 1 standard gallon (liquid)
1 cubic foot = 4/5 of a bushel

Metric Equivalents

LINEAR MEASURE

1 centimeter = 0.3937 in.
1 decimeter = 3.937 in.
= 0.328 feet
1 meter = 39.37 inches
= 1.0936 yards
1 dekameter = 1.9884 rods
1 kilometer = 0.62137 mile
1 in. = 2.54 centimeters
1 ft. = 3.048 decimeters
1 yd. = 0.9144 meter
1 rod = 0.5029 dekameter
1 mile = 1.6093 kilometers

SQUARE MEASURE

1 sq. centimeter = 0.1550 sq. in.
1 sq. decimeter = 0.1076 sq. ft.
1 sq. meter = 1.196 sq. yds.
1 are = 3,054 sq. rds
1 hector = 2.47 acres
1 sq. kilometer = 0.386 sq. mile

1 sq. inch = 6.452 sq. centimeters
1 sq. foot = 9.2903 sq. decimeters
1 sq. yd. = 0.8361 sq. meter
1 sq. rod = 0.2529 are
1 acre = 0.4047 hectare
1 sq. mile = 2.59 sq. kilometers

WEIGHTS

1 gram = 0.03527 ounce
1 kilogram = 2.2046 lbs.
1 metric ton = 1.1023 English tons
1 ounce = 28.35 grams
1 lb. = 0.4536 kilogram
1 English ton = 0.9072 metric ton

Approximate Metric Equivalents

1 decimeter = 4 inches
1 meter = 1.1 yards
1 kilometer = ⅝ of a mile
1 hectare = 2½ acres
1 stere, or cu. meter = ¼ of a cord
1 liter = 1.06 quarts liquid 0.9 quarts dry
1 hektoliter = 2½ bushels
1 kilogram = 2½ lbs.
1 metric ton = 2,200 lbs.

CHEMICAL SUBSTANCES AND THEIR COMMON NAMES

Common Name	*Chemical Name*
Alcohol	Ethyl alcohol
Alum	Potassium aluminium sulphate
Aqua fortis	Nitric acid
Aqua regia	Nitro-hydrochloric acid
Banana ether	Amyl acetate
Black lead	Graphite carbon
Borax	Sodium tetraborate
Brimstone	Sulphur
Calomel	Mercurous chloride
Carbolic acid	Phenol
Caustic potash	Potassium hydroxide
" soda	Sodium hydroxide
Chalk	Calcium carbonate
Choke damp	Carbon dioxide
Chrome yellow	Lead chromate
" green	Chromium oxide
Clay	Aluminium silicate
Copperas	Ferrous sulphate

Corrosive sublimate	Mercuric chloride
Cream of tartar	Potassium hydrogen tartrate
Epsom salts	Magnesium sulphate
Fire damp	Methane
Fusel oil	Amyl alcohol
Glauber's salt	Sodium sulphate
Grape sugar	Glucose
Goulard water	Basic lead acetate
Iron pyrites	Iron disulphide
Laughing gas	Nitrous oxide
Lime, quick	Calcium oxide
" slaked	" hydroxide
Litharge	Lead oxide
Lunar Caustic	Silver nitrate
Marsh gas	Methane
Mosaic gold	Stannic sulphide
Muriatic acid	Hydrochloric acid
Orpiment	Arsenic trisulphide
Paris green	Copper arsenite
Plaster of Paris	Calcium sulphate
Prussian blue	Ferric ferrocyanide
Realgar	Arsenic disulphide
Red lead	Lead oxide
Rochelle salt	Sodium potassium tartrate
Sal ammoniac	Ammonium chloride
Salt, common	Sodium chloride
Salt of tartar	Potassium carbonate
Saltpetre	" nitrate
Salts of lemon	Oxalic acid
Soda, washing	Sodium carbonate
" baking	" hydrogen carbonate
" ash	Sodium carbonate
Spirit of hartshorn	Ammonium hydroxide
Spirits of salt	Hydrochloric acid
Tartar emetic	Potassium antimonyl tartrate
Verdigris	Basic copper acetate
Vermilion	Mercuric sulphide
Vinegar	Acetic acid
Vitriol, blue	Copper sulphate
" green	Ferrous Sulphate
" oil of	Sulphuric acid
" white	Zinc sulphate
Volatile alkali	Ammonium hydroxide
White lead	Basic lead carbonate
Wood alcohol	Methyl alcohol
Zinc white	Zinc oxide

TABLE OF DECIMAL EQUIVALENTS OF FRACTIONS OF AN INCH

1/64 = .015625	11/32 = .34375	43/64 = .671875
1/32 = .03125	23/64 = .359375	11/16 = .6875
3/64 = .046875	3/8 = .375	45/64 = .703125
1/16 = .0625	25/64 = .390625	23/32 = .71875
5/64 = .078125	13/32 = .40625	47/64 = .734375
3/32 = .09375	27/64 = .421875	3/4 = .75
7/64 = .109375	7/16 = .4375	49/64 = .765625
1/8 = .125	29/64 = .453125	25/32 = .78125
9/64 = .140625	15/32 = .46875	51/64 = .796875
5/32 = .15625	31/64 = .484375	13/16 = .8125
11/64 = .171875	1/2 = .50	53/64 = .828125
3/16 = .1875	33/64 = .515625	27/32 = .84375
13/64 = .203125	17/32 = .53125	55/64 = .859375
7/32 = .21875	35/64 = .546875	7/8 = .875
15/64 = .234375	9/16 = .5625	57/64 = .890625
1/4 = .25	37/64 = .578125	29/32 = .90625
17/64 = .265625	19/32 = .59375	59/64 = .921875
9/32 = .28125	39/64 = .609475	15/16 = .9375
19/64 = .296875	5/8 = .625	61/64 = .953125
5/16 = .3125	41/64 = .640625	31/32 = .96875
21/64 = .328125	21/32 = .65625	63/64 = .984375

PHOTOGRAPHIC STUDIO LAMPS

Comparison of White Arc and Mazda Lamps

By Wm. Roy Mott

	Photographic Materials		
For Equal Candle Power	Ordinary	Orthochromatic	Panchromatic
Sun	100	100	100
Sky	181	155	130
Carbon Arc—white flame	257	234	215
Tungsten nitrogen filled clear glass	64	68	76
Tungsten nitrogen filled blue glass	108	99	106

Copyrights on Motion-Pictures

While the United States Copyright Statutes provide for the grant of copyright registrations on motion-pictures, this refers to the complete photographic films from which the motion-picture is exhibited. There are no provisions by which a copyright registration may be secured on an unpublished scenario or story.

As long as the scenario or story remains unpublished, it is protected by the Common Law, which is expressly affirmed in the Copyright Statutes, but it should be remembered that if the work is to remain unpublished for a considerable interval of time, that it is advisable for the author to have several copies of the work made, dated and distributed among friends, so that if necessary, witnesses will be at hand to testify as to the facts. If the scenario or story is printed, it may, of course, be copyrighted as a book.

When the photographic films have been made, they may be copyrighted. The copyright office has divided works of this character into two classes, motion-picture photoplays, and motion-pictures not photoplays, and these classes have been subdivided into published and unpublished works. A published motion-picture is one which is placed on sale, sold or publicly distributed. If the motion-picture which is to be copyrighted has been published, two complete copies of the work or film should be filed with the application for copyright, accompanied by the title and a description of the work. The procedure is the

same whether the work is a photoplay or not. Very often these two copies of the film may be withdrawn from the copyright office after the copyright formalities have been completed. When the work has not been published, the copyright application should be accompanied by a description of the work. If the work is a photoplay, prints should be made from each scene of every act, and if the work is not a photoplay, the prints should be taken from different sections of the complete motion-picture film. These prints should be filed with the description.

In cases where a copyright has been secured on a motion-picture as an unpublished work, the author should remember that if the work is subsequently published, a new entry must be made on the copyright records.

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